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Remedial Investigation Health and Safety Plan

Washington County Lead District
Operable Unit Numbers 1 & 2
Potosi Site
Potosi, Missouri

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ENERGY WATER INFORMATION GOVERNMENT

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Acronyms and Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
ACP	access control point
ANSI	American National Standards Institute
BVSPC	Black & Veatch Special Projects Corp.
CAS	Chemical Abstracts Service
CFR	Code of Federal Regulations
COC	chemicals of concern
CPR	cardiopulmonary resuscitation
CRC	contamination reduction corridor
db	decibel
DOT	Department of Transportation
EE/CA	Engineering Evaluation/Cost Analysis
EPA	US Environmental Protection Agency
FID	flame ionization detector
FP	fundamental parameter
Site HASP	Site Health and Safety Program
Task HASP	Task Health and Safety Plan
HSM	(project) health and safety manager
IDLH	immediately dangerous to life or health
LEL	lower explosive limit
mg/kg	milligrams per kilogram
mg/m^3	milligrams per cubic meter
MSDS	material safety data sheet
MSHA	Mine Safety and Health Administration
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit
PID	photo ionization detector
PM	project manager
PPE	personal protective equipment
ppm	parts per million
PVC	polyvinyl chloride
REL	recommended exposure limits
RI/FS	remedial investigation/ feasibility study
SARA	Superfund Amendments and Reauthorization Act
SCBA	self-contained breathing apparatus
SSC	site safety coordinator
TLV	threshold limit value
TWA	time-weighted average exposure concentration for normal 8-hour (TLV, PEL) or up to a 10-hour (REL) workday and 40-hour workweek
µg/dl	micrograms per deciliter
VDS	vehicle decontamination station
XRF	X-Ray fluorescence

Site Health and Safety Program
Washington County Lead District
Potosi, Missouri

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1.0 Introduction

1.1 Purpose

This site health and safety program (Site HASP) will establish the site-specific health and safety guidelines and procedures for activities at the Potosi Site in Washington County, Missouri. The Site HASP will be based on existing data and site reconnaissance and will be in accordance with Occupational Safety and Health Administration (OSHA). The Site HASP will be approved by the Black & Veatch Special Projects Corp. (BVSPC) health and safety manager (HSM) or designee.

1.2 Scope

Specific information or procedures that are applicable to all operations and tasks at the site are included in Sections 1.0 through 9.0 of this Site HASP. These procedures are applicable to all site activities unless otherwise stated in an appendix. Each appendix addresses a specific task and operation performed at the Potosi Site detailing the hazards and control measures. Each appendix is referred to as a task-specific health and safety plan (Task HASP).

1.3 Compliance with Site HASP

Consistent with the contents of this Site HASP, work will be conducted in a safe and environmentally acceptable manner, and BVSPC and all subcontractors contractually under this HASP are required to comply with the health and safety requirements specified herein. All field personnel under this plan are required to read and familiarize themselves with the contents of this Site HASP and the associated Task HASP. Field personnel will indicate their familiarization with these documents through the entry of a signature and date as specified in Section 11.0, Certification, of this Site HASP and the Task HASP related to the work being performed. Subcontractors who are not contractually under this Site HASP are responsible for developing and implementing a Site HASP that will interface with this Site HASP.

2.0 Site Background

The Washington County area has been mined for lead since the late 1700's. The lead deposits started declining at the end of the Civil War so mining interests turned to Barite (Barium Sulfate). The Barite operations started to decline by the mid 1980's. The extensive mining activities throughout the area, combined with the extended duration of the mining, have resulted in widespread contamination. Remaining mining waste piles are still present in the area and the groundwater has been contaminated from surface water runoff.

The EPA has been conducting ongoing, time-critical removal actions in the site area. By the end of August 2007, the EPA had identified 158 properties with soil exceeding the lead contamination action level of 1,200 ppm. Bottled water is being provided to 120 residences which have contaminated groundwater wells.

The purpose of this sampling effort is to conduct a Remedial Investigation (RI) and Feasibility Study (FS) for the Potosi Site. The RI/FS will consist of two Operable Units (OU1 & OU2). OU1 will involve the sampling and study of the soil contamination and OU2 will focus on the groundwater contamination. A Baseline Human Health Risk Assessment (BHHRA) will be conducted to determine the recommended remediation levels for the site.

2.1 Facility Description

Three contiguous sites are currently identified in the Washington County Lead District. The Potosi Site is southernmost of the sites located in the northeastern portion of Washington County and includes the towns of Potosi, Mineral Point, and Cadet. The Richwoods Site is the northernmost site and is focused around the town of Richwoods in the far northeast corner of Washington County. The Old Mines Site is located between the other two sites along the eastern edge of the County and includes the towns of Old Mines, Kingston, Fertile, and Tiff.

2.2 Summary of Previous Site Activities

An ongoing time-critical removal action is currently being conducted at properties where lead in soil exceeds the current action level of 1,200 parts per million (ppm). By the end of August 2007, 69 of 158 identified contaminated properties have had yard soils replaced in the Potosi Site area. In the Old Mines site area, 60 properties have been identified with contaminated yard soils above the action level of 1,200 ppm and an additional 227 residential properties have been identified with soil lead contamination in the range of

400 ppm to 1,199 ppm. By the end of August 2007 the Richwoods site had 14 properties with soil levels exceeding 1,200 ppm and 52 properties with soil lead contamination level between 400 and 1,199 ppm.

Drinking water from 270 private water wells which exceed the lead contamination value of 15 micrograms per liter (µg/L) have been identified throughout the region. These residences have been provided bottled drinking water. EPA has designated the groundwater contamination as Operable Unit 2 (OU2) and the soil contamination as Operable Unit 1 (OU1). This site was proposed for the National Priorities List (NPL) on September 19, 2007.

2.3 Nature and Extent of Hazardous Materials

Lead in surface soils is the primary contaminant of concern at the Site. During previous site investigations, lead concentrations generally ranged from non-detect to approximately 500 ppm with rare high concentrations of 12,000 ppm.

3.0 Hazard Assessment

Chemicals of concern (COC) commonly found at the OLS are listed in Attachment 2. The table lists the allowable exposure levels for the chemicals, signs and symptoms of exposure, dermal absorption hazards, carcinogenicity, immediately dangerous to life or health (IDLH) values, health hazards, physical hazards, Chemical Abstracts Service (CAS) registry numbers, and physical characteristics. Task-specific information related to the COC are listed in the appropriate Task HASP.

When COC concentrations exceed 1 percent, or 0.1 percent for a carcinogen, a material safety data sheet (MSDS) will be provided in Attachment 3, in accordance with Subsection 8.6.4 (Hazard Communication) of this Site HASP. The MSDSs may not be from the specific manufacturer, distributor, or potentially responsible parties that deposited the COC. Although these are written by a specific manufacturer, they are not meant in any way to suggest that the waste products or contamination on the site came from that particular manufacturer. They are intended to be used solely as an approximation for the waste product to provide safety and health hazard information, including symptoms of exposure, first-aid procedures, and spill control measures.

4.0 Personnel Qualifications

4.1 Training Requirements

4.1.1 Personnel Certification

All personnel who will be engaged in hazardous waste operations must present to the site safety coordinator (SSC) a certificate of completion for an initial 40-hour hazardous waste operations training course or the most recent certificate of completion for an 8-hour refresher course. The course must have been completed within 12 months prior to the individual being onsite performing hazardous waste operations. The training must comply with OSHA regulations found at 29 Code of Federal Regulations (CFR) 1910.120(e). The certification must be presented to the SSC before site activities begin.

All personnel must complete a minimum of 3 days on-the-job training under the direct supervision of a qualified SSC or site supervisor before they are qualified to work unsupervised at a hazardous waste site.

Consistent with OSHA 29 CFR 1910.120 paragraph (e)(4), individuals serving in a supervisory role, such as the field team leader or SSC, require an additional 8 hours of training. BVSPC individuals functioning in an SSC capacity must also have at least 6 days of experience at the level of protection planned for in this HASP. An SSC qualified at a given level of protection is also qualified as an SSC at a lesser level of protection.

At least two people will be trained and currently certified in first aid and adult cardiopulmonary resuscitation (CPR).

Personnel who use air supplied respirators must provide the SSC written certification that they have been trained by a competent person in the proper use, inspection, emergency use, and limitations of the equipment. The training must be current within 12 months prior to the use of the equipment.

Personnel who participate in permitted confined space entry, radiation work, asbestos work, or work involving lockout/tagout of energy sources must provide the SSC written certification that they have been trained in accordance with the applicable OSHA regulations before performing such work.

Personnel who use health and safety monitoring equipment other than the type and model provided by the BVSPC equipment center must provide written certification to the SSC that they have been trained by a competent person in the use, maintenance, calibration, and operation of the equipment before using the equipment.

4.1.2 Safety Meetings

Safety meetings with all team members will be conducted prior to initiating any site activity. In addition, periodic briefings will be held throughout the project, especially when unsafe practices are noted or a change in site conditions requires modifications of the HASP. Periodic meetings will be held at least weekly. Similar meetings will be held with individuals who later become a part of the field team before those individuals take part in site activities.

The Safety Meeting Checklist in Attachment 4 provides a guide of topics to be covered during the initial briefing and which may be covered during periodic meetings. The Safety Meeting Checklist will be used to document the safety meeting topics discussed and the attendance.

The SSC is responsible for conducting and documenting the pre-activity and periodic safety meetings.

4.2 Medical Surveillance Program

All personnel who participate in hazardous waste site investigations will be enrolled in a medical monitoring program prior to initiating site activities. The medical monitoring program will consist of an initial baseline examination, periodic monitoring examinations, and an exit examination.

All personnel who will be engaged in hazardous waste operations must present to the SSC a certificate of completion of a comprehensive medical monitoring examination. The medical examination must have been completed within 12 months prior to the beginning of site activities for BVSPC personnel.

As a minimum, the medical monitoring examination will include the elements listed in Attachment 5.

Site-specific medical monitoring examinations or tests may be required to augment the standard examinations. Any additional examinations or tests required will be listed under the Personnel Qualifications section of the Task HASP.

Personnel who have the potential to wear respirators must present to the SSC written documentation that a physician has determined that they are physically able to perform the work and use the respirator.

5.0 Personal Protective Equipment

5.1 General

The following personal protective equipment (PPE) will be provided, used, and maintained in a sanitary and reliable condition whenever it is necessary because hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants are encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation, or physical contact.

- Suitable eye protectors.
- Head protection.
- Extremities protection.
- Protective clothing.
- Shields and barriers.
- Face protection.
- Respiratory protection.
- Hearing protection.

5.2 Chemical Protective Equipment

5.2.1 Levels of Protection

Personnel will wear chemical protective equipment when activities involve known or suspected atmospheric contamination; when airborne vapors, gases, or particulate may be generated by site activities; or when direct contact with skin-affecting substances may occur.

The specific level of protection and necessary components for each has been divided into four categories according to the degrees of protection afforded:

- Level A: Will be worn when the highest level of respiratory, skin, and eye protection is needed.
  Note: BVSPC personnel are not authorized to work at Level A without additional training and written approval from the BVSPC HSM.
- Level B: Will be worn when the highest level of respiratory protection is needed, but a lesser level of skin protection is required. Level B is the primary level of choice when encountering unknown environments.

- Level C: Will be worn when the criteria for using air-purifying respirators are met and a lesser level of skin protection is needed.
- Level D: Will be worn as a basic work uniform and not in any area with respiratory or skin hazards. It provides minimal protection against chemical hazards.

5.2.2 Chemical Ensembles

The following are the standard chemical protective equipment to be used for all hazardous waste operations. Combinations of chemical protective equipment other than those described for Levels A, B, C, and D protection may be more appropriate and may be used to provide the proper level of protection. Deviations from this standard must be addressed in the Task HASP.

- Level B PPE
  - -- Supplied-air respirator (MSHA/NIOSH approved). Respirators may be positive pressure-demand self-contained breathing apparatus (SCBA) or positive pressure-demand airline respirator (with escape bottle for IDLH or potential for IDLH atmosphere).
  - -- Hooded, chemical-resistant, one-piece suit (Saranex/Tyvek) with double bonded seams.
  - -- Long cotton underwear (optional).
  - -- Outer gloves, chemical-resistant (11 mil nitrile).
  - -- Inner gloves, chemical-resistant (4 mil nitrile or polyvinyl chloride (PVC)).
  - -- Boots, chemical-resistant with steel toe and steel shank.
  - -- Outer boot covers, chemical-resistant, disposable.
  - -- Faceshield (optional).
  - -- Hardhat.
- Level C PPE
  - -- Air purifying respirator (MSHA/NIOSH approved) with an organic vapor/acid gas/high efficiency particulate filter cartridge.
  - -- Chemical-resistant one or two-piece suit (Saranex/Tyvek) with double bonded seams.
  - -- Long cotton underwear (optional).
  - -- Outer gloves, chemical-resistant (11 mil nitrile).

- -- Inner gloves, chemical-resistant (4 mil nitrile).
  - -- Boots, chemical-resistant with steel toe and steel shank.
  - -- Outer boot covers, chemical-resistant, disposable.
  - -- Faceshield (optional).
  - -- Hardhat.
- Level D PPE
  - -- Tyvek coveralls with long sleeves or equivalent.
  - -- Boots with steel toe and steel shank.
  - -- Outer boot covers, chemical-resistant, disposable.
  - -- Outer gloves, chemical-resistant (11 mil nitrile).
  - -- Inner gloves, chemical-resistant (4 mil nitrile).
  - -- Hardhat.
- Modified Level D PPE
  - -- Work clothing.
  - -- Boots with steel toe and steel shank.
  - -- Outer gloves, chemical-resistant (11 mil nitrile).
  - -- Inner gloves, chemical-resistant (4 mil nitrile).
  - -- Hardhat.

5.3 Hazards and Protection Level

The types of hazards for which Levels A, B, C, and D protection are appropriate are described below.

5.3.1 Level A

Level A protection will be used when the following conditions exist:

- The hazardous substance has been identified and requires the highest level of protection for skin, eyes, and respiratory system based on either the measured (or potential for) high concentration of atmospheric vapors, gases, or particulate; or the site operations and work functions involve a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulate of materials that are harmful to skin or capable of being absorbed through the skin.

- Substances with a high degree of hazard to the skin are known or suspected to be present and skin contact is possible.
- Operations are being conducted in contained, poorly ventilated areas and the absence of conditions requiring Level A protection has not yet been determined.

5.3.2 Level B

Level B protection will be used when the following conditions exist:

- The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection, but less skin protection is required.
- The atmosphere contains less than 19.5 percent oxygen.
- The presence of incompletely identified vapors or gases is indicated by a direct reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the skin.
- Note: This involves atmospheres with IDLH concentrations of specific substances that present severe inhalation hazards and that do not represent a severe skin hazard, or that do not meet the criteria for use of air-purifying respirators.

5.3.3 Level C

Level C protection will be used when the following conditions exist:

- The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect or be absorbed through any exposed skin.
- Ambient air monitoring measurements, utilizing a photo ionization detector (PID), indicate any levels above established background levels in work area breathing zones.
- Upon initiation of respiratory protection, all activities shall be in accordance with Section 5.6 of this HASP.

5.3.4 *Level D*

Level D protection will be used when the following conditions exist:

- The atmosphere contains no known hazard.
- Work functions preclude splashes, immersion, or potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

5.3.5 *Modified Level D*

Modified Level D shall be used when the following conditions exist:

- The atmosphere contains no known hazard.
- Public relations dictate low profile activities.
- Work functions preclude splashes, immersion, or potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

5.4 Reassessment of Protection Level

The level of protection provided by PPE will be upgraded or downgraded based upon a change in site conditions or findings of investigations. When a significant change occurs, the hazards will be reassessed. The following are some indicators of the need for reassessment:

- Airborne concentrations of chemicals or physical hazards exceed action levels.
- Commencement of a new work phase, such as the start of drum sampling or work that begins on a different portion of the site.
- Change in job tasks during a work phase.
- Change of weather.
- When temperature extremes or individual medical considerations limit the effectiveness of PPE.
- Contaminants other than those previously identified are encountered.
- Change in ambient levels of contaminants.
- Change in work scope affects the degree of contact with contaminants.
- Detection of contamination by instrument, odor, or sight.

5.5 Inspection of PPE

The user of the PPE is responsible for inspecting the equipment prior to immediate

use. If the user is not familiar with the equipment's limitations, that user will be denied access to the equipment and work zone.

The user's buddy is responsible for periodically checking on the proper use of the protective equipment while in use, as discussed in Section 7.3.

5.6 Respiratory Protection

Respiratory protection at hazardous waste sites consists of a full-face air purifying respirator as a minimum.

Any use of an air supplied system will be specifically addressed in the Task HASP.

Personnel will not be assigned to tasks requiring the use of respirators unless they are physically able to perform the work and use the respirator equipment. These criteria will be documented in writing and provided to the SSC in accordance with Section 4.2.

Personnel who have the potential to wear a respirator onsite must be trained in the proper use of the respirators and their limitations. The training will allow users to handle their respirator to become familiar with all components, select the proper size for a comfortable fit, wear the respirator in normal air to become used to the breathing resistance, visibly conduct a critical component inspection, and administer a positive and negative pressure fit check.

Respirators are not to be worn when conditions prevent a good full seal. Such conditions may be a growth of beard, sideburns, bangs, a skull cap or other clothing that projects under the facepiece, or temple pieces on glasses. To ensure proper protection, the respirator will be thoroughly inspected before each use, and a positive and negative fit check will be performed each time the respirator is donned.

Respirators will be assigned to individuals for their exclusive use during the project. Air purifying respirators will be regularly cleaned and disinfected. As a minimum, respirators will be cleaned after each day's use or more often if necessary. Upon completion of the work task, the respirators will be disassembled, inspected, and thoroughly cleaned and disinfected. Worn or deteriorated parts will be replaced, and the respirators will be stored in a clean and sanitary location in individual plastic bags.

Selection of the respirator is the responsibility of a person qualified by appropriate training or experience and will be noted in the Task HASP. Selection will be based on the physical, chemical, and physiological properties of the air contaminants and the concentration likely to be encountered. The quality of fit and the nature of the work being

performed will also affect the choice of respirators. The capability of the respirators chosen is determined from appropriate governmental approvals, the manufacturer's test, and the qualified person's experience with respirators.

All workers entering the Exclusion Zone or Contamination Reduction Zone at a site where use of a respirator is necessary or anticipated must have passed at least a qualitative fit test in accordance with the guidelines established in the appendix of 29 CFR 1910.1025. Personnel must have been fit tested for the model and size of respirator issued to them. The fit test record must be current within the previous 12 months.

6.0 Monitoring Program

6.1 Real Time Monitoring

Direct reading instruments are used as real time air monitors. The results of the direct reading instruments are compared with the Monitoring Equipment Action Levels (Attachment 6) that describe the protective action to be taken to control exposure. The action levels describe the location of the real time monitoring activity and the action to be taken if predefined values are met or exceeded. Site-specific operations or tasks may have other action levels established. Any change to the action level task will be noted in the appropriate Task HASP.

The frequency and location of all real time monitoring activity is based upon the nature of the site activity. Periodic real time monitoring will be performed, at a minimum, whenever the following activities occur:

- Beginning of site activity.
- Operations change.
- Work begins on a different portion of the site.
- Beginning of invasive site activity.
- Contaminants other than those previously identified are being handled.
- Personnel begin to handle obviously contaminated materials.
- Personnel are handling leaking drums or containers.
- Personnel are performing tasks that are likely to expose them to peak levels of contaminants.
- Instrumental or sensible detection of the presence of a chemical contaminant.
- Change in the weather.

6.2 Air Monitoring Result Logging

Before any field activities commence, the background levels of the site must be read and recorded. Daily background readings must be conducted away from areas of potential contamination to obtain accurate results.

All monitoring results must be recorded in the field log. The monitoring results should indicate the following information:

- Range of readings.
- Mode of readings.

- Time.
- Location of reading.
- Activity during reading.
- Weather conditions.
- Wind direction.
- Action taken.

6.3 Personnel Monitoring

Personnel monitoring will be performed whenever required by an OSHA chemical-specific standard found in 29 CFR 1910.1001-.1048 or when deemed necessary to protect the health of the field team members. All personnel monitoring will be performed in accordance with accepted sampling and analytical procedures as defined by the HSM. Specifics of the monitoring will be as described in the Task HASP.

Personnel who are likely to have exposures above OSHA permissible exposure limits (PELs) or published exposure levels for lead and total dust will participate in a personal air sampling program. Air monitoring will be used to identify and quantify airborne levels of lead and total dust in order to determine the appropriate level of employee protection needed onsite. Specifics of the monitoring will be as described in the Task HASP.

6.4 Operation, Maintenance, and Calibration

The SSC is responsible for the proper operation, maintenance, and calibration of each instrument to be used. The operation, maintenance, and calibration instructions in the equipment manuals will be followed. The equipment manuals will be kept in the Support Zone during field activities. As a minimum, at the beginning of each day, the instruments will be calibrated according to the manual. At the end of each day, a check of the calibration of the instrument will be performed. This end-of-the- day check may be less stringent than the beginning-of-the-day calibration as long as it is verified that accurate readings were taken throughout the day.

6.5 Initial Survey

Prior to any site activities, the SSC will conduct perimeter and general site monitoring, upwind and downwind, to establish background levels.

If information from the site characterization indicates a potential for ionizing

radiation or IDLH condition onsite or if insufficient information is available to demonstrate otherwise, then monitoring will include monitoring with direct reading ionizing radiation or IDLH conditions, including oxygen, explosive, and toxic atmospheres, and visual observations for actual or potential IDLH conditions onsite.

Upon initial entry to an area, representative air monitoring will be conducted using direct reading instruments to identify IDLH conditions and exposures above OSHA PELs or other allowable exposure levels, including exposure to radiation, flammable atmospheres, or oxygen deficient atmospheres.

6.6 Periodic Survey

Periodic monitoring will be conducted when the possibility of an IDLH condition or flammable atmosphere has developed or when there is an indication that exposure may have risen above OSHA PELs or published exposure levels for hazardous substances.

After site activities have commenced, the selective monitoring of high-risk workers, i.e., those who are closest to the source of contaminant generation, is essential. Those employees working closest to the source have the highest likelihood of being exposed to concentrations that exceed established exposure limits or action levels.

Monitoring efforts will focus on personnel most likely to receive the highest exposures and on all personnel likely to be exposed to any substance above the action level or OSHA PEL. High-risk workers will be monitored at least every 30 minutes when the potential for exposure exists.

Monitoring will be performed whenever new work begins on a different position of the site, any time that new contaminants are encountered that differ from those initially encountered, every time a different operation is initiated, whenever employees are working in areas of obvious liquid contamination, or when employees are handling leaking containers.

6.7 Perimeter Monitoring

The SSC is responsible for determining if site activities could negatively impact zones outside the contamination reduction zone. If action levels for airborne contaminants listed in the Action Level Table (Attachment 6) are exceeded, the SSC will perform monitoring at the perimeter of the Contamination Reduction Zone to determine if the contaminants are getting out of the controlled zones. If action levels are exceeded at these locations, the SSC must advise the project manager (PM) and the BVSPC HSM. If

necessary, the control zones will be expanded to compensate for the presence of the contaminants.

If the release of contaminants could negatively impact the health and safety of the surrounding areas, the SSC will contact the local emergency response organization responsible for protecting public health from chemical exposures. This agency will be identified prior to the beginning of site activities as part of the emergency preplanning procedures. The SSC will then notify the site representative, PM, and BVSPC HSM. The PM will notify the client of the chemical release and the actions taken by the SSC. Notification will be made in accordance with Section 9.6, Spills or Leaks.

7.0 Site Control

The objective of site control is to control the activities and movement of people and equipment at hazardous waste sites in order to minimize the potential for worker or public exposure to hazardous substances, the spread of hazardous substance in the environment, or vandalism.

7.1 Site Mapping

A map of the site is located in Task HASP to assist site personnel in planning and organizing response activities.

The Task HASP will contain site maps that are specific to the area where specific tasks will take place. This map will include the following information: prevailing wind direction, magnetic north, site drainage points, previous sampling locations, planned sampling locations, locations of expected contamination, planned control zones, and all natural and manmade topographic features including the location of buildings, containers, impoundments, pits, ponds, tanks, and any other site features.

The Task HASP specific site map will be upgraded to reflect new information gained after initial site entry or from subsequent sampling and analysis activities or changes in site conditions, including changes resulting from accidents, ongoing site operations, hazards not previously identified, new materials introduced onsite, unauthorized entry or vandalism, or weather conditions.

Use of overlays or other mapping techniques may be used to reduce cluttering of information.

7.2 Work Zones

Work zones will be established to:

- Reduce the accidental spread of hazardous substances by workers or equipment from the contaminated areas to the clean areas.
- Confine work activities to the appropriate areas, thereby minimizing the likelihood of accidental exposure.
- Facilitate the location and evacuation of personnel in case of an emergency.

To accomplish this, the site will be divided into as many zones as necessary to ensure minimal employee exposure to hazardous substances. As a minimum, three zones will be

identified: the Exclusion Zone, the Contamination Reduction Zone, and the Support Zone. Movement of personnel and equipment between these zones will be minimized and restricted to specific access control points (ACP) to prevent cross-contamination from contaminated areas to clean areas.

The work site will be divided into these three zones so field personnel can identify where the site hazards exist, so nonessential personnel will not be affected by the hazards, and so the hazards do not leave the zones. Details of the work site control zones will be established by the SSC prior to starting site activities and will be established so that the Support Zone is upwind of the Exclusion Zone or at a distance far enough away that it is not affected by the dispersion of contaminants from the Exclusion Zone.

Following is a description of each work zone and the factors to be considered when establishing each zone.

7.2.1 Exclusion Zone

The Exclusion Zone is the innermost area of the three areas and is considered contaminated. Within this area, levels of protection prescribed in the HASP will be used by all personnel. An ACP will be established at the periphery of the Exclusion Zone to control the flow of personnel and equipment between it and the Contamination Reduction Zone and to check that entrance and exit procedures are followed. The extent of the Exclusion Zone is determined by the following:

(1) Location, nature, and toxicity of the waste materials.

(2) Meteorological conditions affecting potential dispersion of contaminants.

(3) Concern for minimal exposure of the unprotected public and investigation personnel.

(4) Topography.

The Exclusion Zone boundary ("hot line") will be established at a reasonably safe distance from drums, tanks, ponds, liquid run-off, or other physical indicators of hazardous substances. This distance will be established by the SSC before site activities begin and will take into account factors such as physical condition of site, weather conditions, sources of potential hazard, and duration of activity. Subsequent to the start of operations, the boundary may be readjusted based on observation or measurements. The boundary will be physically secured and posted, well defined by geographical boundaries, or otherwise delineated.

The Exclusion Zone could be further divided into zones with different levels of protection for each zone. Based upon environmental measurements or expected onsite work practices, locations within the Exclusion Zone will be defined in accordance with the level of protection required for that area. This procedure will allow for more flexibility in operation, decontamination procedures, and resource utilization.

7.2.2 Contamination Reduction Zone

The area between the Exclusion Zone and the Support Zone is the Contamination Reduction Zone. The purpose of the Contamination Reduction Zone is to prevent the transfer of contaminants that may have been picked up by personnel or equipment leaving the Exclusion Zone. An area within the Contamination Reduction Zone is the contamination reduction corridor (CRC). The CRC is a path that persons or vehicles must take during decontamination. The CRC controls access into and out of the Exclusion Zone and confines decontamination activities to a restricted area. The CRC must be laid with plastic sheeting or equivalent.

At the boundary between the Contamination Reduction Zone and the Exclusion Zone is the "hot line" and ACP. Entrance into the Exclusion Zone requires the wearing of the prescribed PPE and adherence to established site entry procedures. Equipment requirements for working in the Contamination Reduction Zone may be different than those for the Exclusion Zone. At a point close to the "hot line," a decontamination station will be established for both personnel and equipment exiting the Exclusion Zone. Another decontamination station may be established closer to the contamination control line for those working only in the Contamination Reduction Zone. In addition, a vehicle decontamination station will be established as necessary.

The boundary between the Support Zone and the Contamination Reduction Zone is the contamination control line. Entry into the Contamination Reduction Zone from the Support Zone will be through an ACP. Personnel entering at this station must be wearing the prescribed PPE for working in the decontamination area. Exiting the Contamination Reduction Zone to the Support Zone requires the removal of any suspected contaminated PPE and compliance with decontamination procedures.

All facilities and operations located in the Contamination Reduction Zone will be positioned upwind of the actual waste location whenever possible.

7.2.3 *Support Zone*

The Support Zone is the outermost region and is considered a non-contaminated or clean area. It will contain the field office, first-aid area, and other facilities necessary to support site activities. Change rooms, lunch and break areas, supplies, equipment storage areas, and maintenance areas may be located in the Support Zone. Onsite eating, drinking, and smoking will be allowed only in this area. Support facilities will be located upwind from the Exclusion and Contamination Reduction Zones in relation to the prevailing wind whenever possible.

A support center or command center will be established in the Support Zone for each activity and will include the following as a minimum:

- Fully stocked industrial first-aid kit.
- 15-minute eyewash station.
- Fire extinguisher (10A60BC multipurpose dry chemical).
- Telephone or radio communications capability.
- Posted emergency telephone numbers.
- Posted HASP.
- Posted OSHA "Job Safety and Health Protection" poster.
- Posted OSHA noise standard.
- Copy of Black & Veatch "Focus on Health and Safety."
- Posted map with route to hospital.
- Instrument manuals.
- Binder of MSDS.
- BVSPC Health and Safety Manual for Hazardous Waste Site Investigations.
- EPA Standard Operating Safety Guides.

At the discretion of the SSC, the support center may be based in an onsite vehicle.

7.3 Buddy System

Except for Level D work involving non-intrusive methods, the implementation of a buddy system is mandatory for entry into the Contamination Reduction Zones or the Exclusion Zone. The prime objective of the buddy system is to ensure rapid assistance in the event of an emergency.

Each member of the field team will be designated by the SSC to observe at least one

other field team member. The SSC will implement the system at the ACP for personnel entering the Exclusion Zone.

As part of the buddy system, workers will remain close together and maintain visual contact with each other to provide assistance in the event of an emergency. If an emergency situation arises, workers will use the communication signals established and agreed upon prior to entering the contaminated area. The communication signals are discussed in Subsection 8.7.3.

The responsibilities of workers utilizing the buddy system include:

- Providing their buddy with assistance.
- Observing their buddy for signs of chemical exposure.
- Observing their buddy for signs of stress due to temperature extremes.
- Observing their buddy for signs of stress or anxiety while wearing chemical protective clothing.
- Periodically checking the integrity of their buddy's PPE.
- Notifying the SSC or other site supervisory personnel if emergency assistance is needed.

Workers should not rely entirely on the buddy system to ensure that help will be provided in the event of an emergency. To augment this system, workers in contaminated areas should, whenever possible, remain in line-of-sight or communication contact with the SSC or other personnel in the Support Zone.

7.4 Audits

Inspection and audits of the work area will be conducted by the SSC as necessary to determine the effectiveness of the HASP or Task HASP. The HASP and Task HASP will be periodically reviewed by the SSC to keep it current with respect to site conditions. The SSC will report the findings to the site manager. Correcting deficiencies in the effectiveness and application of the HASP is the responsibility of the project manager. Changes to the HASP to address any deficiencies will be made to the Task HASP in accordance with Section 12.0 of the Task HASP.

7.5 Visitors

BVSPC recognizes that all visitors' employers are ultimately responsible for their compliance with all applicable OSHA regulations while on a hazardous waste site. BVSPC

personnel will be courteous to all visitors and adhere to the following procedures for the safety sake of the visitors.

- Visitors are expected to have the permission of the site owner to be on the site.
- The SSC will advise all visitors of the nature, level, and degree of exposure likely as a result of BVSPC related activities and the emergency response procedures that pertain to visitors at the site.
- The SSC will advise all subcontractors coming onto the site of the hazardous chemicals present, effect of exposure, location of the MSDSs, location of the emergency equipment, and emergency plan and evacuation procedures.
- Visitors entering the Contamination Reduction Zone and the Exclusion Zone at the site will be offered an opportunity to read the applicable provisions of this HASP.
- Visitors will be expected to comply with OSHA requirements such as medical monitoring, training, and respiratory protection.
- Visitors will be expected to provide their own PPE.
- In the event that a visitor does not adhere to the provisions of the HASP, the SSC will request the visitor to leave the work area.
- If a visitor interferes with the work activity or poses a safety hazard to anyone onsite, the SSC will terminate work activities and will immediately contact the BVSPC PM and HSM.
- All nonconformance incidents will be recorded in the site log by the SSC.

The client and governmental authorities may choose to adopt this plan or develop their own to protect their onsite employees; however, BVSPC will not take responsibility for compliance of onsite personnel employed by these parties.

8.0 Safety and Emergency Procedures

8.1 Standing Safety Orders

The following standing orders are established to ensure safe work practices. Task-specific standing orders are addressed in the Task HASP.

- Report any sign of radioactivity, explositivity, or unusual conditions to the site supervisor immediately.
- Check in and out through the ACP of the Exclusion Zone.
- Maintain close contact with your buddy in the Exclusion Zone.
- Eating, drinking, chewing gum or tobacco, smoking, or any practices that increase the probability of hand-to-mouth transfers and ingestion of material is prohibited in any controlled area such as the Contaminant Reduction Zone and the Exclusion Zone.
- Whenever decontamination procedures for outer garments are in effect, good personal hygiene will be practiced as soon as possible after the protective garment is removed (i.e., hands will be washed). A shower is recommended immediately after any work period.
- No facial hair that interferes with the effectiveness of a respirator will be permitted on personnel required or potentially required to wear respiratory protection equipment.
- Contact with potentially contaminated surfaces will be avoided whenever possible. Personnel should not walk through puddles, mud, or other discolored surfaces or kneel on the ground. Personnel should not lean, sit, or place equipment on drums, containers, vehicles, or exposed surfaces without plastic covering.
- Medicine and alcohol can magnify the effect from exposure to certain compounds. It will be the responsibility of each BVSPC employee and each subcontractor to notify, on a daily basis, the SSC of any individual who is using prescribed medication. Site personnel will not be allowed onsite while under the influence of alcohol or drugs that cannot be obtained over the counter without a physician's authorization.
- Personnel and equipment in the work areas will be minimized, but consistent with effective site operations.

- All unsafe or inoperable sampling or monitoring equipment left unattended will be identified by the SSC with a "DANGER-DO NOT OPERATE" tag.
- Work will be restricted to daylight hours only--unless there is a reason, such as stated in Section 8.3, and there is adequate lighting as required in 1910.120.

8.2 Medical Emergencies

At least two BVSPC team members conducting hazardous waste operations at the site will have successfully completed a Red Cross sponsored course in adult first aid and cardiopulmonary resuscitation (CPR). Prior to the start of work, the SSC will make arrangements for medical facilities, ambulance service, and medical personnel to be available for prompt attention to the injured.

Onsite activities will require a first-aid station, which will be located within the Support Zone. First-aid kits will be, as a minimum, 16-unit first-aid kits and will be provided in the ratio of one for each 10 persons.

Portable 15-minute emergency eyewash stations will be provided within the Support Zone. Identification markers will be provided to readily denote locations of the eyewash stations.

Emergency telephone numbers and reporting instructions for ambulance, local physician, hospital, poison control center, fire, and police will be conspicuously posted in the Support Zone.

The SSC will act as the emergency coordinator for all medical emergencies. If a person is injured or becomes ill, personnel identified as trained in first aid and CPR will be notified immediately. First aid and CPR will be administered immediately. In all cases, treatment for shock should be considered. After the victim has been attended to, the SSC will be notified. Depending on the severity of the injury or illness, the SSC may notify medical emergency response organizations. If the victim is transferred offsite, the SSC will assign a field team member to accompany the victim.

8.2.1 Chemical Exposure Emergency

If personnel experience any adverse effects or symptoms during field activity, those individuals will notify the SSC. The SSC will assess the situation and make a determination on the extent of medical attention needed. If it is determined that the problem was due to chemical exposure, first aid for chemical exposure will be administered as soon as possible.

If the exposed individual needs to go to the hospital, that person will be transported by an individual who has not been exposed. The Site HASP and available MSDSs will accompany the group to the hospital. The SSC will report the incident to the HSM immediately and submit a written report of the incident to the PM and the HSM within 24 hours.

The following first aid for chemical exposures will be administered as soon as possible:

- Eye Exposure--If contaminated solid or liquid gets into the eyes, they will be washed immediately at the 15-minute emergency eyewash station using large amounts of water and lifting the lower and upper lids occasionally. Medical attention will be obtained immediately. Use of contact lenses is not permitted in the designated Exclusion Zones.
- Skin Exposure--If contaminated solid or liquid gets on the skin, the affected individual will promptly flush the skin for at least 15 minutes, then wash with soap or mild detergent and water. If contaminated solids or liquids penetrate through the clothing, the clothing will be immediately removed, and the skin will be treated for exposure. Medical attention will be obtained if symptoms warrant.
- Inhalation--If a person breathes in a large volume of potentially toxic contaminants, that person will be moved to fresh air at once. If breathing has stopped, CPR will be performed. The affected person will be kept warm and at rest. Medical attention will be obtained immediately.
- Ingestion--If contaminated solid or liquid is swallowed, medical attention will be obtained immediately.

8.2.2 Accident Reporting

Injuries or illnesses that require attention beyond simple first aid or attention by a physician or involve exposure to blood or other potentially infectious materials will be reported to the Worker's Compensation Administrator and the BVSPC HSM as soon as possible, but no later than 24 hours after the accident. In the event of a fatality or more than one hospitalization, the SSC will immediately notify the BVSPC HSM. In turn, the BVSPC HSM will notify to the local OSHA area office within 8 hours. The SSC will complete the appropriate accident report forms and the required State Workers Compensation form. The SSC is responsible for contacting the State Worker's Compensation Office to obtain the

necessary report form. The SSC is also responsible for completing the forms, submitting the originals to the BVSPC HSM, and sending copies to the Workers Compensation Administrator and the PM. Copies will be filed in the project file.

Accidents that must be reported include the following:

- Injury or illness that requires attention beyond simple first aid.
- Injury or illness that requires attention by medical professionals.
- Injury or illness that results in time away from work.
- Injury or illness that restricts the ability of the injured to work.
- Unconsciousness, explained or unexplained.
- Exposure of personnel to blood or other potentially infectious agents.
- Exposure to chemical or physical agents that result in adverse signs or symptoms.

The SSC will summarize all incidents that are near-miss injury or illness accidents or physical accidents on a hazardous waste site investigation activity report form and submit it to the PM and BVSPC HSM as soon as possible.

The SSC is responsible for investigating the cause of all accidents and reporting the findings and corrective actions taken as described above. The SSC may request the assistance of the BVSPC HSM or other personnel to investigate the accident. The final report on the accident is the responsibility of the SSC.

8.2.3 Hospital Route

The route to the hospital is shown and described in Attachment 1. The route to the hospital will be conspicuously posted in the Support Zone. The SSC and key field personnel will drive the route to the hospital emergency room door prior to the start of site activities in order to become familiar with the route. The route will be driven at least weekly to confirm that it is unobstructed.

8.3 Temperature Extremes

8.3.1 Heat Stress Monitoring

Heat stress poses a serious health danger to site workers and may create secondary safety hazards by impairing a worker's coordination and judgment. Heat stress can occur at almost any temperature, but is more likely when PPE is in use.

The use of protective equipment may create heat stress. Monitoring of personnel will commence when the ambient temperature is 70°F (21.1°C) or above. Table 8-1 presents the suggested frequency for such monitoring. Monitoring frequency is dependent on the type of protection worn (permeable or impermeable clothing), the dry bulb temperature, and the amount of sunshine. Monitoring frequency should increase as the ambient temperature increases or as slow recovery rates are observed. Heat stress monitoring should be performed by a person with a current first-aid certification who is trained to recognize heat stress symptoms. For monitoring the body's response to excess heat, one or more of the following techniques will be used.

- Heart rate. Count the radial pulse before site activities and during a 30-second period as early as possible in the monitoring cycle.
  - -- If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next cycle by one third and keep the rest period the same.
  - -- If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following cycle by one third.
- Oral temperature. Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature before site activities and at the end of the monitoring cycle (before the worker drinks liquid).
  - -- If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one third without changing the rest period.
  - -- If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one third.
  - -- Do not permit a worker to wear a semi-permeable or impermeable garment when oral temperature exceeds 100.6°F (38.1°C).

Heat stroke is a life-threatening heat disorder that requires life-saving first aid. Decontamination will be omitted prior to obtaining immediate medical attention.

Heat stress can become life threatening. Unless the victim is grossly contaminated, decontamination will be omitted or minimized and treatment begun immediately.

Proper training and prevention measures will aid in averting serious illness and loss of productivity. Heat stress prevention is particularly important because once a person suffers from heat stroke or heat exhaustion that person may be predisposed to additional heat-related illnesses. To avoid heat stress, the SSC has the authority to take the following steps.

Table 8-1
Suggested Frequency of Physiological Monitoring
for Fit and Acclimatized Workers[a]

Adjusted Temperature[b]	Normal Work Ensemble[c]	Impermeable Ensemble[d]
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5 to 90°F (30.8 to 32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5 to 87.5°F (28.1 to 30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5 to 82.5°F (25.3 to 28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5 to 77.5°F (22.5 to 25.3°C)	After each 150 minutes of work	After each 120 minutes of work

[a] For work levels of 250 kilocalories/hour.
[b] Calculate the adjusted air temperature (ta adj) by using the equation:
ta adj °F = ta °F + (13 x (% ÷ 100) sunshine).
Measure air temperature (ta) with a standard alcohol-in-glass thermometer or equivalent, with the bulb shielded from radiant heat.
Estimate percent sunshine by judging what percent of the time the sun is not covered by clouds that are thick enough to produce a shadow (100% sunshine = no cloud cover and a sharp distinct shadow; 0% sunshine = no shadows).
[c] A normal work ensemble consists of cotton coveralls.
[d] An impermeable ensemble consists of Tyvek coveralls.

- Adjust work schedules.
  - -- Modify work/rest schedules according to monitoring requirements.
  - -- Mandate work slowdowns as needed.
  - -- Perform work during cooler hours of the day if possible or at night if adequate lighting can be provided.
- Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.
- Maintain workers' body fluids at normal levels. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in body fluid, e.g., 8 fluid ounces (0.23 liters) of water must be ingested for approximately every 8 ounces (0.23 kg) of weight loss. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost body fluid. When heavy sweating occurs, workers will be encouraged to drink more. The following strategies may be useful:
  - -- Provide drinking water as needed:
    - * Maintain water temperature at 50 to 60°F (10 to 16.6°C).
    - * Provide dedicated personal bottles or containers that hold approximately 1 quart of water.
    - * Allow dedicated personal bottles of water in the Contamination Reduction Zone.
    - * Have workers drink 16 ounces (0.5 liters) of fluid (preferably water or diluted drinks) before beginning work.
    - * Urge workers to drink a cup or two every 15 to 20 minutes or at each break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per person per day are recommended, but more may be necessary to maintain body weight.
    - * Maintain an additional water source outside the Contamination Reduction Zone.
  - -- Train workers to recognize the symptoms of heat-related illnesses. Table 8-2 presents a summary of typical symptoms and treatment of heat stress.
  - -- Provide a source of water to spray down workers as a measure of preventing or treating heat stress.

Table 8-2

Heat Stress Symptoms and Treatment

Type	Symptoms	Treatment
Heat Related Illness	Localized redness of skin and reduced sweating; reduced tolerance to heat.	Keep skin clean and dry.
Heat Cramps	Muscle spasm and pain in extremities and abdomen.	Remove person to cool area. Give small amounts of salted water.
Heat Exhaustion	Weak pulse; shallow breathing; pale, cool, moist skin; profuse sweating; dizziness; fatigue.	Remove person to cool area, reduce body temperature. Cool by convection. Give small amounts of salted water. Do not allow person to become chilled.
Heat Stroke	Red, hot, dry skin; body temperature of 105°F or greater; nausea; dizziness; confusion; strong rapid pulse; coma. Convulsions may occur.	Seek medical attention immediately. Get victim cool quickly--wrap in wet cloth, spray with cool water, or immerse in cool water. Fan vigorously during transport to hospital. Apply cold packs, if available, avoiding direct contact between skin and pack/ice.

8.3.2 Cold Stress Monitoring

When ambient temperature reaches 45°F (4.4°C) or below, steps should be taken to prevent cold stress.

Excessive exposure to low environmental air temperatures or immersion in low temperature water is usually fatal unless quickly remedied. Workers must be protected from exposure to cold so that the deep core temperature of the body does not fall below 96.8°F (36°C).

Pain in the extremities may be the first early warning of danger to cold stress. Severe shivering may occur if the body temperature drops to 95°F (35°C). Workers exhibiting signs of cold stress or hypothermia must get to a warm area until they are safely able to resume their duties.

To avoid cold stress, the following steps should be taken:

- At air temperatures of 35.6°F (2°C) or less, it is imperative that workers who become immersed in water or whose clothing becomes wet be immediately provided a change of clothing and be treated for hypothermia.
- Provisions for additional total body protection are required if work is performed in an environment at or below 40°F (4°C). The workers will wear protective clothing appropriate for the level of cold and physical activity.
- If only light work is involved and if the clothing on the worker may become wet on the job site, the outer layer of clothing may be of a type impermeable to water. With more severe work under such conditions, the outer layer should be water repellent and should be changed as it becomes wetted. The outer garments must include provisions for easy ventilation in order to prevent wetting of inner layers by sweat. If work is done at normal temperatures or in a hot environment before entering the cold area, employees will make sure that their clothing is not wet as a result of sweating. If the clothing is wet, the employee will change into dry clothes before entering the cold area.
- The workers will change socks and any removable felt insoles at regular daily intervals or use vapor barrier boots. The optimal frequency of changes will be determined empirically and will vary individually and according to the type of shoe worn and how much the individual's feet sweat.

- If extremities, ears, toes, and nose cannot be protected sufficiently to prevent sensation of excessive cold or frostbite by handware, footwear, and face masks, these protective items will be supplied in auxiliary heated versions.
- If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work will be modified or suspended until adequate clothing is made available or until weather conditions improve.

The recommended limits for properly clothed workers for periods of work at temperatures below freezing are listed in Table 8-3.

8.4 Decontamination Procedures

8.4.1 General

All personnel and equipment will be properly decontaminated prior to leaving a site. Decontamination methods could involve physically removing contaminants, neutralizing contaminants by chemical detoxification or disinfection, or removing contaminants through a combination of both physical and chemical means. The types, locations, physical states, and concentrations of contaminants present will determine the degree of decontamination necessary.

To prevent physical transfers of contaminants by people or equipment from onsite to offsite areas, site-specific procedures will be instituted for decontaminating all items leaving the Exclusion Zone and the Contamination Reduction Zone. These procedures will include the decontamination of PPE, vehicles, and all field equipment and the use of correct methods of removing PPE to avoid transfer of contaminants from the clothing to the body and decontamination or disposal. In addition to the decontamination procedures, specific entry and exit routes through the Contamination Reduction Zone will be established for personnel, equipment, and vehicles to minimize the possibilities of additional spread of contaminants. These site-specific decontamination procedures are described in the Task HASP.

Equipment that is not decontaminated or not completely decontaminated will be disposed of onsite or transferred in a controlled manner for subsequent decontamination in a controlled situation. This equipment will be bagged or wrapped in plastic for transferring to the decontamination location. The outside container of the equipment must be labeled as contaminated and list the potential contaminants and associated hazards. To minimize the need to decontaminate equipment, equipment may be packaged or wrapped in a material that will protect it from contamination but does not interfere with its proper operation.

Table 8-3
Cold Work Environment Work Practice

Cooling Power of Wind on Exposed Flesh Expressed as an Equivalent Temperature (under calm conditions)*

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F) 50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER In < hr with dry skin. Maximum danger of false sense of security				INCREASING DANGER Danger from freezing of exposed flesh within one minute.				GREAT DANGER Flesh may freeze within 30 seconds.			
	Trenchfoot and immersion foot may occur at any point on this chart.											

*Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

Work/Warm-up Schedule for Four-Hour Shift*

Air Temperature-Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C (approx.)	°F	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
1. -26° to -28°	-15° to -19°	(Norm. Breaks)	1	(Norm. Breaks)	1	75 min.	2	55 min.	3	40 min.	4
2. -29° to -31°	-20° to -24°	(Norm. Breaks)	1	75 min.	2	55 min.	3	40 min.	4	30 min.	5
3. -32° to -34°	-25° to -29°	75 min.	2	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease	
4. -35° to -37°	-30° to -34°	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease			
5. -38° to -39°	-35° to -39°	40 min.	4	30 min.	5	Non-emergency work should cease					
6. -40° to -42°	-40° to -44°	30 min.	5	Non-emergency work should cease							
7. -43° & below	-45° & below	Non-emergency work should cease									

Notes

1. Schedule applies to moderate to heavy work activity with warm-up breaks of ten (10) minutes in a warm location. For Light-to-Moderate Work (limited physical movement): apply the schedule one step lower. For example, at -30°F with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (Step 5).
2. The following is suggested as a guide for estimating wind velocity. If accurate information is not available: 5 mph: light flag moves; 10 mph: light flag fully extended; 15 mph: raises newspaper sheet; 20 mph: blowing and drifting snow.
3. If only the Wind Chill Factor is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be: 1) special warm-up breaks should be initiated at a wind chill of about 1750 W/m^2/hr, 2) all non-emergency work should have ceased at or before a wind chill of 2250 W/m^2/hr. In general the warm-up schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the absolute temperatures in the colder ranges, since windy conditions rarely prevail at extremely low temperatures.

*From Occupational Health & Safety Division, Saskatchewan Dept. of Labor.

The initial decontamination plan is based upon a nominal case situation. This initial decontamination plan will be modified, adding necessary stations or otherwise adapting it to site conditions when a worst-case situation occurs. Changes in the decontamination plan will be made and noted in the Task HASP by the SSC. If, on visual examination, chemical protective clothing appears grossly contaminated, a thorough decontamination will be required.

The SSC is responsible for selecting and monitoring the decontamination procedures to verify their effectiveness. When the decontamination procedures are found to be ineffective, appropriate steps will be taken to correct the deficiencies.

Methods that have proven to be effective in removal of contaminants are included in Attachment 7.

8.4.2 Emergency Decontamination

In a medical emergency, the primary concern is to prevent the loss of life or severe injury to site personnel. Any person who becomes ill or injured in the Exclusion Zone must be decontaminated to the maximum extent possible before providing the necessary first aid or before permitting the person to enter the Support Zone.

If the injury or illness is serious, at least partial decontamination will be completed. This may be accomplished by the following:

- Complete derobing of the victim and redressing in clean coveralls.
- Wrapping the victim in a blanket or plastic.
- Spot decontamination.

If the injury or illness is minor, full decontamination will be completed and first aid administered prior to transport. The SSC will select the degree of needed decontamination in proportion to the potential hazards posed by the contaminants. When a person who is not fully decontaminated requires transportation to the hospital, the interior surfaces of the vehicle will be covered with plastic to prevent spreading of the contamination.

First aid will be administered while awaiting an ambulance or paramedics.

8.4.3 PPE

Personnel leaving the Exclusion Zone must remove potential contaminants in an orderly and controlled manner to avoid contamination of the person. Primary means of avoiding contamination of the person is to minimize contact with contaminants during site

activities. Secondary means is to assume contamination and systematically reduce the contamination prior to doffing PPE.

Personal decontamination involves the sequential doffing of PPE, starting with the most heavily contaminated and working to the least contaminated. This progression, in combination with separating each step of the decontamination procedure by a minimum of 3 feet, ensures contamination decreases as the person moves from one station to another further along the line. Wash and rinse steps may be needed to reduce the contamination to a level that is safe to handle. Since it is virtually impossible to prevent the transfer of contaminants on protective clothing to the wearer, thorough decontamination of the chemical protective clothing is necessary. When done effectively, the amount of substance remaining on the chemical protective clothing is greatly reduced and the possibility of transfer is proportionately reduced. Therefore, heavily contaminated disposable chemical protective clothing should be washed and rinsed to minimize the spread of the contaminants during doffing. Unsoiled disposable chemical protective clothing may not require the wash and rinse steps.

Polyethylene plastic sheeting will be placed on the ground in the CRC, and the decontamination stations will be arranged on top of the plastic. The first station will be located within the Exclusion Zone and will be the station where gross contamination is removed.

As a minimum, the level of protection required for the personnel assisting with personnel decontamination will be the most protective of either Level D or one level less than the level worn in the Exclusion Zone.

The SSC is responsible for monitoring the effectiveness of the decontamination procedures.

8.4.4 Instruments

Instrument decontamination requires, as a minimum, that all external surfaces and surfaces that come in contact with contaminants be wiped with a cloth dampened with a trisodium phosphate detergent and wiped dry. Contamination should be prevented by packaging or wrapping the instrument in a material that will protect it from contamination but does not interfere with its proper operation.

Instruments that are internally contaminated or not completely decontaminated will be transferred in a controlled manner for subsequent decontamination. These instruments

will be bagged or wrapped in plastic for transfer to the decontamination location. The outside container of the instrument must be labeled as contaminated and list the potential contaminants and associated hazards.

8.4.5 Equipment

Equipment that comes in direct contact with a contaminant will be decontaminated and shown to be clean before it is returned to the owner or equipment center.

8.4.6 Decontamination Solutions

The standard decontamination solutions will be a solution of Alconox or equivalent detergent. Generally, a solution of trisodium phosphate detergent is sufficient for most site applications. The decontamination solution will be prepared in accordance with the manufacturer's instructions. In general, potable water is a sufficient rinse; however, for specific equipment, deionized or distilled water may be required for decontamination.

Other decontamination solutions are listed in Attachment 7.

8.4.7 Vehicle Decontamination Station

At sites where drill rigs or other vehicles are used for onsite activities, it may be necessary to construct a vehicle decontamination station (VDS) to prevent the spread of contaminants to offsite locations. Typically, the VDS is a sloping area lined with plastic sheeting and gravel so that decontamination solutions can flow into a lined collection pit, sump, or trench. The pit contents can then be pumped into Department of Transportation (DOT) approved 55-gallon drums or containers for later disposal. Other VDS configurations include plastic sheeting with wood runways to accommodate vehicles.

It is imperative that all vehicles used onsite be thoroughly decontaminated before being allowed to leave the site. Special attention should be paid to the treads or tracks and interior surfaces. Decontamination can be expedited if vehicle interiors are lined with plastic sheeting prior to commencing onsite activities.

When using a central vehicular decontamination station, gross dirt must be removed from the vehicle before it leaves the Contamination Reduction Zone.

8.5 Disposition of Decontamination Wastes

All materials and equipment used for decontamination must be disposed of properly.

Clothing, tools, buckets, brushes, and other equipment that is contaminated must be secured in containers and labeled. Clothing not completely decontaminated onsite will be double bagged before it is removed from the site. Spent decontamination soap/rinse solutions will be transferred to drums that are labeled and disposed of with other substances onsite.

Commercial laundries or cleaning establishments that clean protective clothing or equipment will be informed of the potentially harmful effects of exposures to the contaminants.

8.5.1 Disposal Procedures

All wash and rinse water will be transferred to a container that will be covered and labeled as to contents and stored onsite. If 55-gallon drums are used, they will be DOT approved drums, and lids will be put on all drums in the event of rain and at the close of each work day. Drums will be supported on wood blocks or pallets to reduce corrosion. Means and method of disposal of decontamination solutions will be decided on a case-by-case basis and will be detailed in the Task HASP.

8.5.2 Contamination Reduction Corridor Breakdown

When the CRC is no longer needed, it will be closed down. All disposable clothing and plastic sheeting used during the operation will be double bagged and contained onsite in a labeled DOT approved drum or container. All wash tubs, pails, containers, etc., will be thoroughly washed, rinsed, and dried prior to removal from the site.

8.6 Communications

Communication systems will be established at the site for both internal and external communication for both routine and emergency operations.

8.6.1 Internal Communication

Internal communication refers to communication between workers operating in the Exclusion Zone or the Contamination Reduction Zone or to communication from the Support Zone to these workers. Internal communication will be used for the following:

- Alert team members to emergency situations.

- Convey safety information (e.g., air time remaining in SCBA, heat stress check, hazards detected).
- Communicate changes in the work to be accomplished.
- Maintain site control.

The internal communication system may include standard communication devices such as radio, audible signals from noise makers, or visual signals from hand or body movements.

Identification of individual workers is necessary to ensure commands are addressed to the right worker. This may be accomplished by one of several methods, depending on the specifics of the site activities.

- Marking the suit with the worker's name.
- Color coding, numbering, or symbols for long-distance identification.
- Use of names for short distance, small work force tasks.

Standard audible and visual communication signals are listed in Subsection 8.6.3.

8.6.2 External Communications

External communications refers to communication between onsite and offsite personnel. An external communication system must be maintained for the following:

- Coordinate emergency response efforts with offsite responders.
- Report progress or problems to management.
- Maintain contact with essential offsite personnel.

The primary means of external communication are telephone and radio. Where telephones are not available immediately at the site, all team members will be informed of the location and dialing instructions of the nearest telephone. The correct change and necessary telephone numbers will be made readily available in the Support Zone. If a radio is used, its location will be clearly marked. Clear instructions for its use will be posted with the radio at all times.

If access to external communications takes longer than 5 minutes to reach, the field team will be equipped to have immediate access to emergency response organizations.

Specifics of the internal and external communication methods will be detailed in the Task HASP.

8.6.3 Communication Signals

The purpose of communication signals is to alert members of emergencies, convey safety information, communicate changes in the work to be accomplished, and maintain site control.

- Audible Internal Communications (whistle, vehicle horn, personal air horn).

Signal	Definition
One long blast	Evacuate area
Two short blasts	Localized problem, be on the alert
Two long blasts	All clear, reentry permitted
Three short blasts	Cease work operations

- Visual Internal Communications (hand signals).

Signal	Definition
Hands clutching throat	Out of air/cannot breath
Hands on top of head	Need assistance
Thumbs up	OK/I am alright/I understand
Thumbs down	No/negative
Arms waiving upright	Send backup support
Grip partners wrist	Exit area immediately
Cross arms above head	Cease work operations

8.6.4 Hazard Communication

The following apply to all chemicals where the chemical concentration exceeds 1 percent or 0.1 percent for a carcinogen. This section is applicable to all chemicals brought

onsite, used onsite, or present as contaminants onsite.

All chemicals will be accompanied by a MSDS. All MSDSs will be included in Attachment 3 of the Site HASP and made available to all personnel.

All containers of chemicals will be properly labeled with the chemical name and appropriate hazard warning statement.

All team members will be trained in the following at the initial safety briefing or wherever the presence of chemicals is identified.

- Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area.
- Physical and health hazards of the chemical in the work area.
- Measures employees can take to protect themselves from these hazards.
- Location of the MSDSs.
- Explanation of the labeling system.

8.7 Confined Space Entry Procedures

BVSPC team members are not authorized to enter confined spaces without written authorization from the BVSPC HSM or designee. Confined spaces are defined as spaces that meet the following criteria.

- Large enough for a person to bodily enter.
- Limited or restricted means of entry or exit.
- Not designed for continuous employee occupancy.

Entry into a confined space must comply with the BVSPC standard operating procedure for entry into confined spaces.

9.0 Emergency Action Plan

In the event of an emergency, the SSC will act as the emergency coordinator. The SSC will assess the emergency and determine if onsite resources are capable of responding to the emergency without exceeding the level of training and resources available. Otherwise, emergency response by BVSPC field team members will be to immediately evacuate the site in the event of a non-medical emergency.

9.1 Preplanning

Arrangements will be made with the local response community (i.e., fire department or local response services) for them to respond to emergencies that may occur during site operations. The local response community will be provided information regarding site activities, including the types of operations being conducted at the site, the type and degree of contamination at the site, the location of the work zone, and any other relevant information that may be necessary for an appropriate response. Such information will be provided to a supervisory level representative of the emergency response organization prior to the commencement of site operations.

9.2 Reporting Emergencies

Emergencies of all types must be immediately reported to the SSC through established communication means. If the SSC is not available, the emergency must be reported to the nearest BVSPC supervisory representative.

The SSC will assess the emergency and determine if onsite resources are capable of responding to the emergency without exceeding the level of training and resources available. If offsite emergency response organizations are needed, they will be notified in accordance with the preplanning arrangements.

9.3 Notification

In the event of an emergency, personnel will take direction from the SSC. The SSC will notify the appropriate emergency response organization necessary to mitigate the emergency. As soon as possible, the SSC will make contact with the BVSPC PM and the BVSPC HSM. If an emergency response organization is notified to respond, the SSC will dispatch a representative to the site entrance to escort the emergency response organization to

the emergency scene. The SSC will act as the liaison with the officer-in-charge of the emergency response organization.

9.4 Emergency Contacts

Attachment 1 lists emergency telephone numbers and reporting instructions for ambulance, physician, hospital, poison control center, fire, police, local hazardous materials response team, emergency rescue team, client contact, and site contact. Attachment 1 will be conspicuously posted in the Support Zone. Where phone numbers are not available for the abovementioned organizations, the list will so indicate.

The status and capabilities of emergency response teams that will provide assistance at the time of an emergency are described in the Task HASP.

9.5 Fire or Explosion

In the event of a fire or explosion, the local fire department will be notified immediately. The SSC or designated alternate will advise the fire commander of the location, nature, and identification of the hazardous materials onsite. The SSC will maintain contact with the emergency response organization officer-in-charge.

If it is safe to do so, site personnel may respond as follows:

- Use fire fighting equipment available onsite to control or extinguish incipient fires.
- Remove or isolate flammable or other hazardous materials that may contribute to the fire.
- Inform the site supervisor immediately.
- Inform the client immediately.

9.6 Spills or Leaks

In the event of a spill or a leak, site personnel will take the following actions:

- Inform the site manager immediately.
- Inform the client immediately.
- Locate the source of the spillage and stop the flow if it can be done safely.
- Contain the spill.
- Notify the local emergency response organization if the spill cannot be controlled.

- Notify the local fire department if the chemical release has the potential of impacting the public health or environment offsite.
- Request offsite assistance in recovery of spilled material.

If the SSC determines that a situation exists that could threaten human health or the environment outside the site area, the local fire department will be notified immediately. In accordance with EPA Superfund and Reauthorization Amendment (SARA) Title III, the SSC will also immediately notify the National Response Center and the BVSPC PM. The telephone report will include:

(1) Name and telephone number of reporter.
(2) Name and address of facility.
(3) Time and type of incident (e.g., release, fire).
(4) Name and quantity of materials(s) involved, to the extent known, and the location of the discharge within the facility.
(5) Extent of injuries, if any.
(6) Possible hazards to human health or the environment outside the site area.
(7) Actions the person reporting the discharge proposes to take to contain, clean up, and remove the substance.

9.7 Evacuation Procedures

At each work site, an evacuation route and rally point will be identified. The evacuation route will be selected to direct field personnel away from the Exclusion Zone to the nearest exit. During evacuation, field personnel will make every effort to evacuate with their assigned buddy. The evacuation route will avoid high hazard areas and efficiently move personnel away from the emergency site.

The evacuation route will be towards a rally point. The rally point is a common area where all field team members are to meet following an evacuation. The purpose of the rally point is to remove personnel to a safe location away from the emergency and away from high hazard areas and to where they can be accounted for by the SSC. In the event of missing personnel, the SSC will immediately notify the emergency response organizations. The SSC will provide whatever assistance is requested by the emergency response organizations if search and rescue is necessary. If the designated rally point is proximate to the hazard, the SSC will authorize the evacuees to move to a safer rally point. All personnel will remain at the rally point until authorized to leave by the SSC.

9.8 Critique of Response and Follow-up

A follow-up meeting will be held after any emergency situation to assess the actions taken. The meeting will be attended by the SSC and other individuals as appropriate. A record of the meeting will be kept by the SSC. Recommendations from the meeting will be incorporated into the future responses to emergency situations.

10.0 Team Member Responsibilities

10.1 Managerial Responsibility

10.1.1 Health and Safety Manager

The HSM is responsible for providing the PM with assistance and support with regard to all regulatory and safety aspects of site activity.

10.1.2 Project Manager

The BVSPC PM is responsible for technical direction and overall project administration. As a part of that function, the PM will ensure that, at a minimum, BVSPC's project plans meet OSHA requirements and that the health and safety of all site personnel are a primary concern.

10.2 Team Organization/Responsibility

The following personnel organization is critical to the planned activities at the site. The organizational structure is assigned and will be reviewed and updated periodically by the PM.

10.2.1 Site Manager

The BVSPC site manager is responsible for leading the team in the planned field activities, including paying close attention to site conditions as they may affect the health and safety of all team members during their onsite activities. The SSC will assist the site manager in the site activities.

10.2.2 Site Safety Coordinator

The SSC has total responsibility for ensuring that the provisions of this HASP are adequate and implemented in the field. Changing field conditions may require decisions to be made concerning adequate protection programs. Therefore, it is vital that personnel assigned as SSC be experienced and meet the additional training requirements specified by OSHA in 29 CFR 1910.120 and the BVSPC Safety and Health Program. The SSC is also responsible for conducting site inspections on a regular basis to ensure the effectiveness of the HASP.

10.2.3 Field Team

The field team is the BVSPC team personnel responsible for performing the activities described in the HASP under the site manager's oversight. Each member is expected to handle the assigned duties with attention to the inherent hazards involved. All field team members agree to adhere to the provisions in the HASP.

11.0 Certification

All field team members are required to read and familiarize themselves with the contents of this HASP and acknowledge their agreement to comply with the provisions of the plan through the entry of a signature and date on the section below. Any changes to the HASP will be made in accordance with Section 12.0, Record of Changes.

By my signature, I certify that:

- I have read,
- I understand, and
- I will comply with the Site Health and Safety Plan for the OLS.

Printed Name	Signature	Date	Affiliation

By my signature, I certify that:

- I have read,
- I understand, and
- I will comply with the Site Health and Safety Plan for the OLS.

Printed Name	Signature	Date	Affiliation

12.0 Record of Changes

Changes to this HASP must be made on the following form and submitted to the BVSPC PM and HSM for their approval. Field activities that have the potential for exposure to contaminants will be halted until the HASP has been modified to reflect changed conditions and the BVSPC HSM has reviewed and approved the changes. All field team members who are affected by the changes must initial that they have been apprised of those changes.

Revision Number	Subject	Section/Page	Initials/Date

Attachment 1
Emergency Information
Washington County – Potosi Lead Site

Washington County Hospital
Hospital Emergency Route

Route to: Washington County Hospital
300 Heath Way Drive
Potosi, Missouri 63664
573-438-5451

See the following page for hospital routes and map.

- From the field office, go Southwest on N. Missouri St toward High Street.
- Turn left onto High street.
- Turn right onto Henry Bub Drive.
- End at 300 Heath Way Drive.

Total distance is approximately 1 mile with a travel time of 2 minutes.

Hospital Map

Emergency Contacts

Organization	Name	Position	Phone Number
Fire	Potosi Fire Department	Local Fire	911 or 573-438-5465
Washington County Hospital	Emergency Department	Emergency Department	573-438-5451
Police	Washington County Sheriff	Washington County Sheriff	911 or 573-438-5478
BVSPC	Curt McCoy	Site Manager	913-458-6520
	Shelly Pizzi	Health and Safety Manager	913-458-4516
Work Care	Dr. Elayne Theriault	Consulting Physician	800-455-6155
Client	Bruce Morrison	EPA Task Order Project Officer (TOPO)	913-551-7755
Poison Control			402-354-5555
CS3, Inc			800-910-9398

Table A2

Chemicals of Concern and Applicable Regulatory Standards at the OLS

Contaminant	Exposure Route	TWA Exposure Limits	IDLH	Hazard/Symptoms
Lead CAS # 7439-92-1	Inhalation, Ingestion, Skin/Eye Contact	TLV: 0.15 mg/m^3 PEL: 0.05 mg/m^3	700 mg/m^3	Weakness, lassitude, insomnia, facial pallor, anorexia, low-weight, constipation, abdominal pain, anemia, wrist and ankle paralysis

Notes and Abbreviations:

IDLH Source: U.S. Department of Health and Human Services, NIOSH Pocket Guide

OSHA PEL/Carcinogen/
ACGIH TLV Sources: American Conference of Government Industrial Hygienists, Guide to Occupational Exposure Values

OSHA PEL: Occupational Safety and Health Administration Permissible Exposure Limit.

TWA: Time-weighted average exposure concentration for normal 8-hour (TLV, PEL) or up to a 10-hour (REL) workday and 40-hour workweek.

IDLH: Immediately dangerous to life or health concentrations.

Carcinogen Designations:

TLV-A2:	Suspected human carcinogen, based on either limited epidemiologic evidence or demonstration.
EPA-B:	Probable human carcinogen; weight of evidence of human carcinogenicity based on epidemiologic studies is limited; agents for which weight of evidence of carcinogenicity based on animal studies is sufficient.
EPA-B-2:	Sufficient evidence from animal studies; inadequate evidence or no data from epidemiologic studies.
IARC-2A:	Probably carcinogenic to humans; limited human evidence, sufficient evidence in experimental animals.
IARC-2B:	Possibly carcinogenic to humans; limited evidence in humans in the absence of sufficient evidence in experimental animals.
MAK-A1:	Capable of inducing malignant tumors as shown by experience with humans.
MAK-A2:	Unmistakably carcinogenic in animal experimentation only.
NIOSH-X:	Carcinogen defined with no further categorization.
NTP-2:	Reasonably anticipated to be a carcinogen; limited evidence from studies in humans or sufficient evidence from studies in experimental animals.

Attachment 2
Chemicals of Concern and Applicable Regulatory Standards
Washington County - Potosi Lead Site

Attachment 3
Material Safety Data Sheets
Washington County – Potosi Lead Site

Material Safety Data Sheets
Contents

On jobs requiring equipment, a field reference manual is normally sent to the field. The field reference manual contains copies of the following material safety data sheets (MSDSs). Copies of these MSDSs can be found in the Task HASP for the site.

- Nitric Acid.
- Methanol.

Note: Although these MSDS are written by specific manufacturers, they are not meant in any way to suggest that the waste products or contamination on the site come from that particular manufacturer. They are intended to be used solely as an approximation for the waste product to provide safety and health hazard information, including symptoms of exposure, first-aid procedures, and spill control measures.

Attachment 4
Safety Meeting Checklist
Washington County – Potosi Lead Site

Washington County – Potosi Lead Site
Safety Meeting Checklist

_____ _____
Site Safety Coordinator Date

Attendee Initials:

SSC Initials

_____ Review Immediate and Pertinent Work Plans
_____ Collect Current Medical Monitoring Certificates
_____ Collect Current Respirator Fit Test Record

Collect Current Training Certificates:
_____ Hazardous Waste Operations 40 hr (OSHA 1910.120)
_____ Hazardous Waste Operations Refresher (OSHA 1910.120)
_____ Hazardous Waste Operations Supervisor (OSHA 1910.120)
_____ Confined Space Entry
_____ Air Supplied Respirators
_____ Monitoring Equipment (other than BVSPC supplied)
_____ First Aid/CPR
_____ Other
_____ Review Standing Safety Orders
_____ Review Personal Protective Equipment Requirements

Review Emergency Action Plan:
_____ Anticipated Emergency Response Discussed
_____ Identify First Aid/CPR Trained Personnel to Team Members
_____ Personnel Trained to Respond Identified to Team
_____ Review Evacuation and Rally Procedures with Team Members

Conduct Chemical Hazard Training for Team Members
_____ Detection Methods
_____ Protective Measures
_____ Location of MSDS
_____ Labeling System Used Onsite
_____ Signs/Symptoms of Overexposure

Review Communication Systems with Team Members

_____ Internal System
_____ External System
_____ Review Changes to HASP
_____ Point Out Postings:
_____ Emergency Phone List
_____ Hospital Emergency Route/Map
_____ OSHA Poster
_____ HASP

Subcontractor Safety

_____ MSDS Submitted to BVSPC SSC
_____ Emergency Equipment
_____ Reference Materials

Note: If an item is not applicable, insert "N/A."

Safety briefings are to be held prior to initiating any site activity and at such times as necessary to ensure that employees are apprised of the site safety plan and that the plan is being followed.

Attachment 5
Medical Monitoring Examination Elements
Washington County – Potosi Lead Site

Medical Monitoring Examination Elements

Baseline

Medical History
Respirator User Assessment
Assessment for Hazardous Waste Worker
Physical Examination
Electrocardiogram (EKG)
Pulmonary Function Test
Chest X-ray
Audiometry
Vision Screen
Stool Occult Blood
Urinalysis
Hematology
Blood Chemistry
Coagulation
Physician Discretion Exams

Annual

Baseline Minus the X-ray
Physician Discretion Exams

Exit

Baseline Minus EKG and Respirator User Assessment
Physician Discretion Exams
Physician Discretion Exams
Annual Chest X-ray
Tetanus Booster
Serum PCB levels
RBC Cholinesterase
Plasma Cholinesterase
Stress EKG
24 hr Dioxin in Urine
Heavy Metals in Urine

Attachment 6
Monitoring Equipment Action Levels
Washington County – Potosi Lead Site

Table A6-1
Monitoring Equipment
Action Levels

Instrument	Reading	Action
O_2 Meter (measure at source for LEL Meter, in breathing zone for PPE).	Less than 19.5% O_2	Withdraw. Ventilate with fresh air. Explosimeter readings not valid if O_2 <10%.
	Greater than 23% O_2	Withdraw. Explosion hazard. Consult with BVSPC HSM.
LEL Meter (measure at source)	Up to 5% LEL	Continue activities.
	5-10% LEL	Continue: ID source.
	Greater than 10% LEL	Withdraw. Explosion hazard. Consult with BVSPC HSM.
Organic Vapor Detector (PID or FID) (measure in breathing zone)	Background	Level D
	Up to 5 ppm above background	Level C
	Greater than 5 ppm above background	Withdraw. Consult with BVSPC HSM.
Hydrogen Cyanide Draeger Tube Electrochemical Instrument	Any indication	Withdraw. Consult with BVSPC HSM.
Dust Meter	Up to 2 mg/m^3	Level D, based on dust levels only.
	Greater than 2 mg/m^3	Level C, based on dust levels only.
Noise Meter	Up to 85 db	Continue activities.
	Greater than 85 db	Hearing protection required.

Attachment 7
Decontamination Methods
Washington County – Potosi Lead Site

Table A7-1

Personnel Decontamination

Method *	Surface	Action	Technique	Advantages	Disadvantages
Soap and water	Skin and hands	Emulsifies and dissolves contaminate	Wash 2-3 minutes and monitor. Do not wash more than 3-4 times.	Readily available and effective for most contamination.	Continued washing will defat the skin. Indiscriminate washing of other than affected parts may spread contamination.
Lava soap, soft brush, and water	Skin and hands	Emulsifies, dissolves, and erodes	Use light pressure with heavy lather. Wash for 2 minutes, 3 times. Rinse and monitor. Use care not to scratch or erode the skin. Apply lanolin or hand cream to prevent chapping	Readily available and effective for most contamination.	Continued washing will abrade the skin.
Tide or other detergent (plain)	Skin and hands	Emulsifies, dissolves, and erodes	Make into a paste. Use with additional water with a mild scrubbing action. Use care not to erode the skin.	Slightly more effective than washing with soap.	Will defat and abrade skin and must be used with care.
Mixture of 50% Tide and 50% cornmeal	Skin and hands	Emulsifies, dissolves, and erodes	Make into a paste. Use with additional water with a mild scrubbing action. Use care not to erode the skin.	Slightly more effective than washing with soap.	Will defat and abrade skin and must be used with care.

Table A7-2
Area and Material Decontamination

Method *	Surface	Action	Technique	Advantages	Disadvantages
Vacuum cleaning	Dry surfaces	Removes contaminated dust by suction	Use conventional vacuum technique with efficient filter.	Good on dry, porous surfaces. Avoids water reactions.	All dust must be filtered out of exhaust. Machine is contaminated.
Water	All nonporous surfaces (metal, painted, plastic, etc.)	Dissolves and erodes	For large surfaces. Hose with high pressure water at an optimum distance of 15 to 20 feet. Spray vertical surfaces at an angle of incidence of 30° to 40°; work from top to bottom to avoid recontamination. Work upwind to avoid spray. Determine cleaning rate experimentally, if possible; otherwise, use a rate of 4 square feet per minute.	All water equipment may be utilized. Allows operation to be carried out from a distance. Contamination may be reduced by 50%. Water equipment may be used for solutions of other decontaminating agents.	Drainage must be controlled. Not suitable for porous materials. Oiled surfaces cannot be decontaminated. Not applicable on dry contaminated surfaces (use vacuum); not applicable on porous surfaces such as wood, concrete, canvas, etc. Spray will be contaminated.
	All surfaces	Dissolve and erodes	For small surfaces Blot up liquid and handwipe with water and appropriate commercial detergent.	Extremely effective if done immediately after spill and on non-porous surfaces.	Of little value in the decontamination of large areas, longstanding contaminants, and porous surfaces.
Steam	Nonporous surfaces (especially painted or oiled surfaces)	Dissolves and erodes	Work from top to bottom and from upwind. Clean surface at a rate of 4 square feet per minute. The cleaning efficiency of stream will be greatly increased by using detergent.	Contamination may be reduced approximately 90% on painted surfaces.	Stream subject to same limitations as water. Spray hazard makes the wearing of waterproof outfits necessary.

Table A7-2, Continued
Area and Material Decontamination

Method *	Surface	Action	Technique	Advantages	Disadvantages
Detergents	Nonporous surfaces (metal, painted, glass, plastic, etc.)	Emulsifies contaminant and increases wetting power of water and cleaning efficiency of steam	Rub surface 1 minute with a rag moistened with detergent solution then wipe with dry rag; use clean surface of the rag for each application. Use a power rotary brush with pressure feed for more efficient cleaning. Apply solution from a distance with a pressure proportioned. Do not allow solution to drip onto other surface. Mist application is all that is necessary.	Dissolve industrial film and other materials which hold contamination. Contamination may be reduced by 90%.	May require personal contact with surface. May not be efficient on longstanding contamination.
Complexing agents	Nonporous surfaces (especially unweathered surfaces, i.e., no rust or calcareous growth)	Forms soluble complexes with contaminated material	Complexing agent solution should contain 3% (by weight) or agent. Spray surface with solution. Keep surface moist 30 minutes by spraying with solution periodically. After 30 minutes, flush material off with water. Complexing agents may be used on vertical and overhead surfaces by adding chemical foam (sodium carbonate or aluminum sulfate).	Holds contamination in solution. Contamination may be reduced by 75% in 4 minutes on unweathered surfaces. Easily stored; carbonates and citrates are nontoxic, noncorrosive.	Requires application for 5 to 30 minutes. Little penetrating power; of small value on weathered surfaces.

Table A7-2, Continued
Area and Material Decontamination

Method *	Surface	Action	Technique	Advantages	Disadvantages
Organic solvents	Nonporous surfaces (greasy or waxed surfaces, paint or plastic finishes, etc.)	Dissolves organic materials (oil, paint, etc.)	Immerse entire unit in solvent or apply by wiping procedure (see Detergents).	Quick dissolving action. Recovery of solvent possible by distillation.	Requires good ventilation and fire precautions. Toxic to personnel. Material bulky.
Inorganic acids	Metal surfaces (especially with porous deposits, i.e., rust or calcareous growth); circulatory pipe systems	Dissolve porous deposits	Use dip-bath procedure for movable items. Acid should be kept at a concentration of 1 to 2 normal (9 to 18% hydrochloric, 3 to 6% sulfuric acid). Leave on weathered surfaces for 1 hour. Flush surface with water, scrub with a water-detergent solution, and rinse. Leave in pipe circulatory system 2 to 4 hours; flush with plain water, a water-detergent solution, then again with plain water.	Corrosive action on metal and porous deposits. Corrosive action may be moderated by addition of corrosion inhibitors to solution.	Personal hazard. Wear goggles, rubber boots, gloves, and aprons. Good ventilation required because of toxicity and explosive gases. Acid mixtures should not be heated. Possibility of excessive corrosion if used without inhibitors. Sulfuric acid not effective on calcareous deposits.
Acid mixtures: Hydrochloric, sulfuric, acetic, citric acids, acetates, citrates	Nonporous surfaces (especially with porous deposits); circulatory pipe systems	Dissolves porous deposits	Same as for inorganic acids. A typical mixture consist of 0.1 gal hydrochloric acid, 0.2 lb sodium acetate, and 1 gal water	Contamination may reduced by 90% in 1 hour (unweathered surfaces). More easily handled than inorganic acid solution.	Weathered surfaces may require prolonged treatment. Same safety precautions as required for inorganic acids.

Table A7-2, Continued
Area and Material Decontamination

Method *	Surface	Action	Technique	Advantages	Disadvantages
Caustics: lye (solidum hydroxide) calcium hydroxide potassium hydroxide	Painted surfaces (horizontal)	Softens paint (harsh method)	Allow paint-remover solution to remain on surface until paint is softened to the point where it may be washed off with water. Remove remaining paint with long-handled scrapers. Typical paint remover solution: 10 gal water, 4 lb lye, 6 lb boiler compound, 0.75 lb cornstarch.	Minimum contact with contaminated surfaces. Easily stored.	Personal hazard (will cause burns). Reaction slow; thus, it is not efficient on vertical or overhead surfaces. Should not be used on aluminum or magnesium.
Trisodium phosphate	Painted surfaces (vertical, overhead)	Softens paint (mild method)	Apply about 10% solution by rubbing and wiping procedure (see Detergent)	Contamination may be reduced to tolerance in one or two applications.	Destructive effective on paint. Should not be used on aluminum or magnesium.
Abrasion	Nonporous surfaces	Removes surfaces	Use conventional procedures, such as sanding, filing, and chipping; keep surface damp to avoid dust hazard.	Contamination may be reduced to as low a level as desired.	Impracticable for porous surfaces because of penetration by moisture.
Sandblasting	Nonporous	Removes surfaces	Keep sand wet to lessen	Practical for large surface areas	Contamination spread over area must be removed.
Vacuum blasting	Porous and non-porous surfaces	Removes surface; traps and controls contaminated waste.	Hold tool flush to surface to prevent escape of contamination.	Contaminated waste ready for disposal. Safety abrasion method.	Contamination of equipment.
* Begin with the first listed method and then proceed step by step to the more severe methods, as necessary.					

Appendix A
Washington County - Potosi Lead Site
Surface Soil/Dust/Tap Water Sampling
Task Health and Safety Plan

Prepared by: _____ Date: _____
Author

Reviewed by: _____ Date: _____
Project Manager

Approved by: _____ Date: _____
Black & Veatch Special Projects, Corp.
Health and Safety Manager

Expiration Date: _____

The following Task HASP is health and safety information specific to the tasks described within. This Task HASP is an extension of the HASP and as such must be used in conjunction with that document.

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Attachment A - Material Safety Data Sheets (MSDS) for Nitric Acid and Methanol

Attachment B - Radiation Safety Chapter from Innov-X Systems Instruction Manual

1.0 Scope of Task Work

This Task HASP applies to all Black & Veatch Special Projects, Corp. (BVSPC) personnel. This Task HASP also applies to any BVSPC subcontractors unless otherwise noted.

The surface soil sampling work will include characterization of residential surface soils. Surface soil samples from residential yards areas will be collected at approximately 50 residences and 20 mining waste locations then analyzed for Lead (Pb) by XRF analysis methods. The wipe and vacuum dust sampling work will include the characterization of interior dust in residential properties. Vacuum samples will be analyzed for the same metals as soil samples. Wipe samples will be analyzed for lead only. Tap water samples will also be collected for additional risk assessment data.

BVSPC field team will consist of the following members:

- Field Team Leader: Anita Buggins
- Site Safety Coordinator: Anita Buggins
- Field Crew: Professional Environmental Engineers, Inc. (PE)
- Alternate BVSPC personnel will be utilized according to need and availability.

The activities will begin in the June of 2008 and last approximately two months.

2.0 Task-Specific Background

2.1 Soil Sampling

Field portable XRF analyzers are based upon the principle that radioisotope excitation sources can be used to identify inorganic elements by providing excitation energies. The Innov-X Systems Inspector shall be utilized during this effort. This XRF unit features a miniature x-ray tube for the radiation source and eliminates the regulatory and safety issues associated with isotope systems. The analyzer allows for both in situ and intrusive (sample cup) analysis; however, only intrusive analysis will be utilized for the residential yard soils at the Site.

After obtaining access to each property, surface soil samples will be collected at each residence. One composite surface soil sample will be collected at each residence. Five soil samples will be collected from four different quadrants (defined below) in the yard and the 20 aliquots will be composited into a single sample. Pertinent information regarding the sampling of the property will be recorded on the field sheet and in the field logbook.

Each property will be divided into the same four quadrants that were previously sampled by BVSPC. First, the property will be divided into front and back yard halves. Then the front and back yard halves will each be divided into two approximately equal quadrants. Each sampling team will be provided with the previously completed field sheet for the residence. One composite sample composed of five aliquots of equal mass will be collected from each quadrant. Each aliquot will be collected from a randomly selected location in the quadrant and from the top 1 inch of soil away from influences of the drip zone. All quadrants will be thoroughly mixed into one composite soil sample. The drip zone includes the area within 3 feet of the foundation of all buildings on the property.

Mining wastes which exist within easy and repetitive access to area residents will be sampled at 20 locations throughout the Potosi site area. Exact sampling locations will be determined after a thorough site reconnaissance and inventory of suspect areas. Each sampling location will consist of a 5-point composite sample as done for residential yard sampling. The GPS coordinates of the composite sample center shall be recorded along with an approximate measurement of the surface area represented by the composite sample.

2.2 Dust Sampling

Dust samples will be collected using two methods: wipe sampling and vacuum sampling. Dust sample results can be expressed as a lead loading (weight of lead per area sampled, typically $\mu g/ft^2$), or lead concentration (weight of lead per weight of sample, typically $\mu g/g$) (EPA, 1995).

2.2.1 Wipe Sampling

Wipe dust collection is limited to reporting lead results in loading terms ($\mu g/ft^2$). Wipe collection involves using a moist towelette (i.e., baby wipes) and wiping the dust from the sample location with a known area. The wipe is then placed in a sample container and sent to a laboratory for analysis.

2.2.2 Vacuum Sampling

Vacuum dust collection can generate both lead loading and lead concentration results. Vacuum collection requires the use of a special vacuum sampler. The purpose of the High Volume Small Surface Sampler (HVS3) is to collect a representative sample of surface dust which can then be analyzed for lead (CS3, Inc., 1998). The sample location of known area is vacuumed and the dust is collected directly into the sample container which can then be sent to a laboratory for analysis. During cleaning or examination of the HVS3, the vacuum will remain unplugged. While in operation, the HVS3 will be in connection with a portable ground fault circuit interrupter. Decontamination of the vacuum sampler involves the use of methanol. Methanol presents an explosion hazard due to the low flash point of 54° F.

2.3 Tap Water Sampling

One tap water sample will be taken at selected residences where dust/soil sampling is conducted. The sample is to be collected from the well head or an outside faucet. The water shall be allowed to purge for at least 5 minutes prior to sample collection. A hose will be connected to the faucet and the water is to be purged away from the foundation of the residence or well. A single one liter cubitainer of water will be collected, preserved with one milliliter of nitric acid, and then placed on ice prior to delivery to the EPA laboratory for analysis.

3.0 Hazard Assessment

Chemical hazards are discussed in the Site HASP and include lead, methanol, and nitric acid. Nitric acid handling will require eye protection to protect from splash and nitrile gloves. The hazard that exists for nitric acid contact is minimal while transferring acid from squeeze bottle to tap water sample cubitainer. Care shall be taken to avoid dripping or spilling product during transfer and all spills shall be cleaned immediately and flushed with water.

Methanol is to be used for decontamination of the dust vacuum sampler. Methanol handling will require eye protection and the use of neoprene based gloves. Nitrile gloves are not chemically compatible with methyl alcohol. The hazard that exists while handling methanol in a confined space is considered to be quite severe due to inhalation and explosion potential.

Equipment hazards include operating the XRF analyzer. When the analyzer is in operation, the radiation field is confined to a small area around the vicinity of the probe. Attachment B is the radiation safety chapter from Innov-X Systems Instruction Manual for X-ray Fluorescence Spectometers. Measured radiation levels when properly operating the Innov-X unit were less than 0.1 mrem/hr, well below the permissible limit of 2.0 mrem/hr. This type of unit utilizes no radioisotope for an excitation source therefore there is no need for leak inspections or making special shipping arrangements.

Physical hazards include encountering unfriendly residential pets. Each field team member while in the field will carry pepper spray. If possible, arrangements will be made with home owners to contain dogs during sample collection.

4.0 Personnel Qualifications

Personnel working at the site will have the following required training and medical monitoring:

- 40-Hr Initial Hazardous Waste Operations.
- 8-Hr Hazardous Waste Operations Refresher.
- Medical Monitoring Program as described in the Site HASP with blood lead levels monitored.
- 8-Hr Hazardous Waste Operations Supervisor (BVSPC personnel).
- First Aid/CPR (2 personnel per field team).
- Radiation Safety and Monitoring (XRF Analysis personnel).

Copies of all training and monitoring certifications are maintained in the project file.

5.0 Personal Protective Equipment

All work associated with the collection of surface soil, and dust samples will be performed in modified level D as described in the Site HASP. Neoprene based gloves and eye protection will be utilized while using methanol to decontaminate vacuum sample equipment. Nitrile gloves and eye protection will be used while handling nitric acid in preserving tap water samples. All work associated with the XRF analysis of surface soils will be performed in modified level D as described in the Site HASP.

6.0 Monitoring Program

No monitoring program is planned for this site because the lead concentrations are low. Therefore, no modifications are expected to the Site HASP regarding the personal monitoring program.

No radiation monitoring will be preformed based upon experience gathered at other sites using the Innov-X XRF units. No exposure is created when the XRF units are used in accordance with manufacturer's suggestions.

7.0 Site Control

The designated areas of the Washington County – Potosi Lead Site are within publicly and privately owned areas. Access to these areas will be approved by the landowners prior to sampling activities

The nearest medical facility is Washington County Hospital in Potossi, Missouri. It is located at 300 Health Way Drive. A map depicting the hospital as well as written directions is included in the Site HASP Attachment 1: Emergency Information of the Site HASP.

8.0 Safety and Emergency Procedures

No modifications are expected to the Site HASP regarding safety and emergency procedures. The team of two in the field will have a cellullar phone for communication as well as access to an automobile for transportation. In the event of an emergency, field personnel will direct assistance to their current sampling location.

Clothing that has received nitric acid splash should be removed as soon as possible and washed before reuse. Skin which has contacted nitric acid is to be flushed with water for 15 minutes. In the event of splash of nitric acid into eyes, flushing should continue for 15 minutes, lifting the lower and upper eyelids during flushing. Identification markers will be provided to readily denote locations of the eyewash stations. Medical attention will be pursued immediately for skin and eye exposure.

Methanol shall only be used in a well ventilated area around no heat, sparks, flame, static electricity, or other potential sources of ignition. Methanol is to be stored in polyethylene safety cans in a cool, dry, well ventilated space away from any fire or spark sources. Neoprene based gloves will be used while handling methyl alcohol as well as eye protection. Skin which has contacted methanol is to be flushed with water for 15 minutes. In the event of splash of methanol into eyes, flushing should continue for 15 minutes, lifting the lower and upper eyelids during flushing. Medical attention will be pursued immediately for skin and eye exposure.

Material Safety Data Sheets (MSDS) are contained in Attachment A for nitric acid and methanol. These sheets should be consulted for additional information regarding all information relating to these chemicals.

The field team leader will be responsible for the XRF Analyzer being turned off when not in use, and for the proper handling of the equipment as outlined in the Innov-X Systems instruction manual.

9.0 Emergency Action Plan

In the event of an emergency, a table of emergency contacts is presented in Attachment 1: Emergency Information in the Site HASP. Innov-X can be contacted at (866) 446-6689 for questions regarding the XRF Analyzer or can be reached at www.innov-xsys.com.

10.0 Team Member Responsibilities

Team member responsibilities are outlined in the Site HASP. One team of two will be conducting the sampling on site. Each team member's responsibilities will be clearly outlined prior to the start of field activities. As additional team members come on site, all team member responsibilities will be explained to them prior to their conducting any field activities.

11.0 Certification

By my signature, I certify that:

- I have read,
- I understand, and
- I will abide by the Task Health and Safety Plan for the Washington County – Potosi Lead Site.

Printed Name	Signature	Date	Affiliation

12.0 Record of Changes

Changes to this Task HASP must be made on the following form and submitted to BVSPC PM and HSM for their approval. Field activities that have the potential for exposure to contaminants will be halted until the Task HASP has been modified to reflect changed conditions and the BVSPC HSM has reviewed and approved the changes. All field team members who are affected by the changes must initial that they have been apprised of those changes.

Revision Number	Subject	Section/Page	Initials/Date

Attachment A

MSDS for Nitric Acid and Methanol

MSDS Number: N3660 * * * * * *Effective Date: 02/15/08* * * * * *Supercedes: 05/06/05*

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS | J.T.Baker

24 Hour Emergency Telephone: 866-928-0111
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

NITRIC ACID, 50-70%

1. Product Identification

Synonyms: Aqua Fortis; Azotic Acid; Nitric Acid 50%; Nitric Acid 65%; nitric acid 69-70%
CAS No.: 7697-37-2
Molecular Weight: 63.01
Chemical Formula: HNO3
Product Codes:
J.T. Baker: 5371, 5796, 5801, 5826, 5856, 5876, 5896, 9597, 9598, 9600, 9601, 9602, 9603, 9604, 9606, 9607, 9608, 9610, 9616, 9617, 9670
Mallinckrodt: 1409, 2704, 2705, 2716, 6623, H862, H988, H993, H998, V077, V650

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Nitric Acid	7697-37-2	50 - 70%	Yes
Water	7732-18-5	30 - 50%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED. INHALATION MAY CAUSE LUNG AND TOOTH DAMAGE.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 4 - Extreme (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 3 - Severe (Oxidizer)
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison.

Inhalation:
Corrosive! Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract.
Ingestion:
Corrosive! Swallowing nitric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract.
Skin Contact:
Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color.
Eye Contact:
Corrosive! Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Chronic Exposure:
Long-term exposure to concentrated vapors may cause erosion of teeth and lung damage. Long-term exposures seldom occur due to the corrosive properties of the acid.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders, eye disease, or cardiopulmonary diseases may be more susceptible to the effects of this substance.

4. First Aid Measures

Immediate first aid treatment reduces the health effects of this substance.
Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give

oxygen. Call a physician.
Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

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5. Fire Fighting Measures

Fire:
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. Can react with metals to release flammable hydrogen gas.
Explosion:
Reacts explosively with combustible organic or readily oxidizable materials such as: alcohols, turpentine, charcoal, organic refuse, metal powder, hydrogen sulfide, etc. Reacts with most metals to release hydrogen gas which can form explosive mixtures with air.
Fire Extinguishing Media:
Water spray may be used to keep fire exposed containers cool. Do not get water inside container.
Special Information:
Increases the flammability of combustible, organic and readily oxidizable materials. In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB® acid neutralizers are recommended for spills of this product.

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7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, the acid should always be added slowly to water and in small amounts. Never use hot water and never add water to the acid. Water added to acid can cause uncontrolled boiling and splashing. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
2 ppm (TWA), 4 ppm (STEL)
-ACGIH Threshold Limit Value (TLV):
2 ppm (TWA); 4 ppm (STEL)

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Nitric acid is an oxidizer and should not come in contact with cartridges and canisters that contain oxidizable materials, such as activated charcoal. Canister-type respirators using sorbents are ineffective.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
Colorless to yellowish liquid.
Odor:
Suffocating, acrid.
Solubility:
Infinitely soluble.
Specific Gravity:
1.41
pH:
1.0 (0.1M solution)

% Volatiles by volume @ 21C (70F):
100 (as water and acid)
Boiling Point:
122C (252F)
Melting Point:
-42C (-44F)
Vapor Density (Air=1):
2-3
Vapor Pressure (mm Hg):
48 @ 20C (68F)
Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Containers may burst when heated.
Hazardous Decomposition Products:
When heated to decomposition, emits toxic nitrogen oxides fumes and hydrogen nitrate. Will react with water or steam to produce heat and toxic and corrosive fumes.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
A dangerously powerful oxidizing agent, concentrated nitric acid is incompatible with most substances, especially strong bases, metallic powders, carbides, hydrogen sulfide, turpentine, and combustible organics.
Conditions to Avoid:
Light and heat.

---

11. Toxicological Information

Nitric acid: Inhalation rat LC50: 244 ppm (NO2)/30M; Investigated as a mutagen, reproductive effector. Oral (human) LDLo: 430 mg/kg.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Nitric Acid (7697-37-2)	No	No	None
Water (7732-18-5)	No	No	None

---

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Although not a listed RCRA hazardous waste, this material may exhibit one or more characteristics of a hazardous waste and require appropriate analysis to determine specific disposal requirements. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: NITRIC ACID
Hazard Class: 8
UN/NA: UN2031
Packing Group: II
Information reported for product/size: 6.5GL

International (Water, I.M.O.)

Proper Shipping Name: NITRIC ACID (WITH NOT MORE THAN 70% NITRIC ACID)
Hazard Class: 8
UN/NA: UN2031
Packing Group: II
Information reported for product/size: 6.5GL

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

Ingredient	TSCA	EC	Japan	Australia
Nitric Acid (7697-37-2)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---------------------------------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.

Nitric Acid (7697-37-2)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Nitric Acid (7697-37-2)	1000	1000	Yes	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Nitric Acid (7697-37-2)	1000	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: 2PE
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 0 Other: **Oxidizer**
Label Hazard Warning:
POISON! DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED. INHALATION MAY CAUSE LUNG AND TOOTH DAMAGE.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe vapor or mist.
Use only with adequate ventilation.
Wash thoroughly after handling.
Keep from contact with clothing and other combustible materials.
Do not store near combustible materials.
Store in a tightly closed container.
Remove and wash contaminated clothing promptly.
Label First Aid:
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an

unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

No Changes.

Disclaimer:

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****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS Number: M2015 * * * * * *Effective Date: 05/04/07* * * * * *Supercedes: 08/10/04*

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

METHYL ALCOHOL

1. Product Identification

Synonyms: Wood alcohol; methanol; carbinol
CAS No.: 67-56-1
Molecular Weight: 32.04
Chemical Formula: CH3OH
Product Codes:
J.T. Baker: 5370, 5595, 5794, 5811, 5842, 5869, 9049, 9063, 9065, 9066, 9067, 9069, 9070, 9071, 9073, 9076, 9077, 9091, 9093, 9096, 9097, 9098, 9263, 9822, 9830, V654, XL-319
Mallinckrodt: 3004, 3006, 3016, 3017, 3018, 3024, 3041, 3701, 4295, 5160, 8814, H080, H488, H603, H985, V079, V571

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Methyl Alcohol	67-56-1	100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! VAPOR HARMFUL. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CANNOT BE MADE NONPOISONOUS. FLAMMABLE LIQUID AND VAPOR. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM AND LIVER.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 1 - Slight
Contact Rating: 3 - Severe (Life)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Once absorbed into the body, it is very slowly eliminated. Symptoms of overexposure may include headache, drowsiness, nausea, vomiting, blurred vision, blindness, coma, and death. A person may get better but then worse again up to 30 hours later.
Ingestion:
Toxic. Symptoms parallel inhalation. Can intoxicate and cause blindness. Usual fatal dose: 100-125 milliliters.
Skin Contact:
Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure.
Eye Contact:
Irritant. Continued exposure may cause eye lesions.
Chronic Exposure:
Marked impairment of vision has been reported. Repeated or prolonged exposure may cause skin irritation.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired liver or kidney function may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion:

Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact:

Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

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5. Fire Fighting Measures

Fire:

Flash point: 12C (54F) CC
Autoignition temperature: 464C (867F)
Flammable limits in air % by volume:
lel: 6.0; uel: 36
Flammable Liquid and Vapor!

Explosion:

Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Moderate explosion hazard and dangerous fire hazard when exposed to heat, sparks or flames. Sensitive to static discharge.

Fire Extinguishing Media:

Use alcohol foam, dry chemical or carbon dioxide. (Water may be ineffective.)

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Use water spray to blanket fire, cool fire exposed containers, and to flush non-ignited spills or vapors away from fire. Vapors can flow along surfaces to distant ignition source and flash back.

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6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Do Not attempt to clean empty containers since residue is difficult to remove. Do not pressurize, cut, weld, braze, solder, drill, grind or expose such containers to heat, sparks, flame, static electricity or other sources of ignition: they may explode and cause injury or death.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Methyl Alcohol:
- OSHA Permissible Exposure Limit (PEL):
200 ppm (TWA)
- ACGIH Threshold Limit Value (TLV):
200 ppm (TWA), 250 ppm (STEL) skin

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details. Use explosion-proof equipment.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Breathing air quality must meet the requirements of the OSHA respiratory protection standard (29CFR1910.134). This substance has poor warning properties.

Skin Protection:
Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure.

Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.

Odor:
Characteristic odor.

Solubility:
Miscible in water.
Specific Gravity:
0.8
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
64.5C (147F)
Melting Point:
-98C (-144F)
Vapor Density (Air=1):
1.1
Vapor Pressure (mm Hg):
97 @ 20C (68F)
Evaporation Rate (BuAc=1):
5.9

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
May form carbon dioxide, carbon monoxide, and formaldehyde when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizing agents such as nitrates, perchlorates or sulfuric acid. Will attack some forms of plastics, rubber, and coatings. May react with metallic aluminum and generate hydrogen gas.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

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11. Toxicological Information

Methyl Alcohol (Methanol) Oral rat LD50: 5628 mg/kg; inhalation rat LC50: 64000 ppm/4H; skin rabbit LD50: 15800 mg/kg; Irritation data-standard Draize test: skin, rabbit: 20mg/24 hr. Moderate; eye, rabbit: 100 mg/24 hr. Moderate. Investigated as a mutagen, reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Methyl Alcohol (67-56-1)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. When released into water, this material is expected to readily biodegrade. When released into the air, this material is expected to exist in the aerosol phase with a short half-life. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into air, this material is expected to have a half-life between 10 and 30 days. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition.
Environmental Toxicity:
This material is expected to be slightly toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: METHANOL
Hazard Class: 3
UN/NA: UN1230
Packing Group: II
Information reported for product/size: 358LB

International (Water, I.M.O.)

Proper Shipping Name: METHANOL
Hazard Class: 3, 6.1
UN/NA: UN1230
Packing Group: II
Information reported for product/size: 358LB

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Methyl Alcohol (67-56-1)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Methyl Alcohol (67-56-1)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Methyl Alcohol (67-56-1)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Methyl Alcohol (67-56-1)	5000	U154	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Pure / Liquid)

Australian Hazchem Code: 2PE
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 0
Label Hazard Warning:
POISON! DANGER! VAPOR HARMFUL. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CANNOT BE MADE NONPOISONOUS. FLAMMABLE LIQUID AND VAPOR. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM AND LIVER.
Label Precautions:
Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.
Wash thoroughly after handling.
Keep container closed.

Use only with adequate ventilation.
Keep away from heat, sparks and flame.

Label First Aid:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

No Changes.

Disclaimer:

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Prepared by: Environmental Health & Safety
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Attachment B

Radiation Safety Chapter from Innov-X Systems Instruction Manual

3.0 Radiation Safety

3.0 IMPORTANT SAFETY INFORMATION

THE XRF SHOULD NOT BE POINTED AT ANYONE OR ANY BODY PART, ENERGIZED OR DE-ENERGIZED! The safe and proper operation of the Innov-X XRF instruments is the highest priority. These instruments produce ionizing radiation and should ONLY be operated by individuals, who have been trained by Innov-X Systems, Inc. and recieved a manufacturer's training certificate. Innov-X recommends that operators and companies implement a written Radiation Safety Program, with safety components specific to the site and application of use of the instrument. The Radiation Safety Program should be reviewed annually and revised appropriately by a competent individual.

The Innov-X analyzer is a very safe instrument when used according to manufacturer's recommended safety procedures as detailed in this chapter.

Radiation levels during testing are < 0.1 mR/hr on all surfaces of the analyzer except at or near the exit port for the radiation. This means that if an operator follows standard operating procedures, they will not obtain any detectable radiation dose above naturally occurring background radiation, on their hand while holding the analyzer, or on any area of their body.

This chapter details specifics of the radiation levels. It covers both standard (safe) and un-safe methods of operation, it provides radiation emission information, and also provides dose estimates for unsafe operations.

3.1 GENERAL SAFETY PRECAUTIONS AND INFORMATION:

Retain and follow all product safety and operating instructions. Observe all warnings on the product and in the operating instructions. To reduce the risk of bodily injury, electric shock, fire and damage to the equipment, observe the following precautions:

Heed service markings. Except as explained in this documentation, do not service any Innov-X product yourself. Opening or removing covers may expose you to electric shock. Service needed on components inside these compartments should be done only by Innov-X Systems, INC.

Damage requiring service:

- The power cord, plug or battery contacts for the battery charger are damaged.
- Liquid has been spilled or an object has fallen onto the instrument.
- The instrument has been exposed to rain or water.
- The instrument has been dropped or damaged.
- There are noticeable signs of overheating.
- The instrument does not operate normally when you follow operating instructions.

Safety Precautions:

Use the correct external power source: Ensure that the voltage is appropriate (100V-240 V/ 50-60 Hz) for charging the battery packs. Do not overload an electrical outlet, power strip, or convenience receptacle. The overall load should not exceed 80% of the branch circuit rating.

Use cables and power cords properly:
Plug the battery charger into a grounded electrical outlet that is easily accessible at all times. Do not pull on cords and cables. When unplugging the cord form the electrical outlet, grasp and pull the cord by the plug.

Handle battery packs properly; do not: disassemble, crush, puncture, short external contacts, dispose of in fire or water, or expose a battery pack to temperatures higher than 60 °C (140 °F).Do not attempt to open or service a battery pack.

WARNING: Danger of explosion if battery is incorrectly substituted. Replace only with Innov-X specified batteries. Used batteries may be returned to Innov-X Systems for disposal.

3.2 INNOV-X SYSTEMS – RECOMMENDED RADIATION SAFETY TRAINING COMPONENTS

Individual Companies and States have specific regulations and guidelines for the use of X-ray tube generated ionizing radiation. The purpose of the recommendations below is to provide generic guidance for an ALARA - best practice - approach to radiation safety. These recommendations do not replace the requirement to understand and comply with the specific policies of any state or organization.

1. **Proper Usage.** Never point the instrument at another person. Never point the instrument into the air and perform a test. Never hold a sample in your hand and test that part of the sample.
2. **Establish Controlled Areas.** The location of storage and use should be of restricted access to limit potential exposure to ionizing radiation. In use, the target should not be hand held and the area at least three paces beyond the target should be unoccupied.
3. **Specific Controls.** The instrument should be stored, in a locked case, or locked cabinets when not in use. When in use, it must remain in the direct control of a factory trained, certified operator.
4. **Time - Distance - Shielding Policies.** Operators should minimize the time around the energized instrument, maximize the distance from the instrument window, and shoot into high density materials whenever possible. Under no circumstances should the operator point the instrument at themselves or others.
5. **Prevent Exposure to Ionizing Radiation.** - All reasonable measures, including labeling, operator training and certification, and the concepts of time, distance, & shielding, should be implemented to limit radiation exposure to ***as low as reasonably achievable*** (ALARA).
6. **Personal Monitoring.** Radiation control regulations may require implementation of a radiation monitoring program, where each instrument operator wears a film badge or TLD detector for an initial period of 1 year to establish a baseline exposure record. Continuing radiation monitoring after this period is recommended, but may be discontinued if accepted by radiation control regulators. Please refer to Sect. 3.10 for a list of providers of film badges.

3.3 INNOV-X SAFETY FEATURES

The Innov-X analyzer is very safe when used correctly, however the analyzer does emit radiation through the analyzer window, and all precautions must be taken to reduce exposure to this radiation. In order to minimize the possibility of accidental exposure, the following safety features are standard in all Innov-X analyzers.

1. "Deadman" trigger. The trigger must be held for the duration of the test. This requires that the user consciously depress the trigger whenever x-rays are emitted, and ensures that the analyzer is attended at all times while x-rays are emitted.

   Upon completion of safety training, an INNOV-X certified trainer may deactivate this feature upon request. The deactivation of the trigger is recommended only if long tests are required (such as for soil mode) and if the unit is used primarily by only 1 or 2 users who utilize it frequently, in a

very controlled environment. In situations where multiple users are sharing the unit, it is recommended that the deadman trigger remain active.

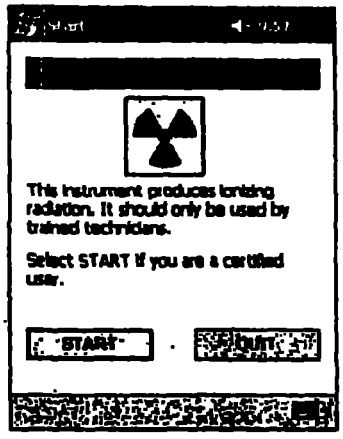
2. Software Trigger lock. In addition to the mechanical trigger lock, a secondary software trigger lock exists. Before using the trigger, the user must tap on a lock icon located in the lower right hand corner of the iPAQ screen. The user must then confirm that they wish to unlock the trigger. If the instrument is used continuously, the software trigger lock will remain off. If five minutes elapse between tests, the trigger will lock automatically.

3. Software Proximity sensor. The software requires that a sample be present in front of the analyzing window. This prevents the accidental exposure of bystanders to an open beam. If the analyzer detects that a sample is not present, it will abort the test and shut off x-rays two seconds after the test is started.

3.4 PERFORMING A TEST FOLLOWING APPROPRIATE RADIATION SAFETY PROCEDURES

Starting the Analyzer:

When an operator opens the Innov-X software on the iPAQ, he or she will be presented with the display shown to the right. Provided an operator has received training from an authorized Innov-X trainer, he/she should tap the START button to begin using the analyzer. From this point the operator is presented with the main menu of the analyzer to choose an operating mode and begin testing (described in Chapter 4). The remainder of this section is dedicated to operational and safety aspects that pertain to safe use and storage of the analyzer.



Starting a test using the trigger.

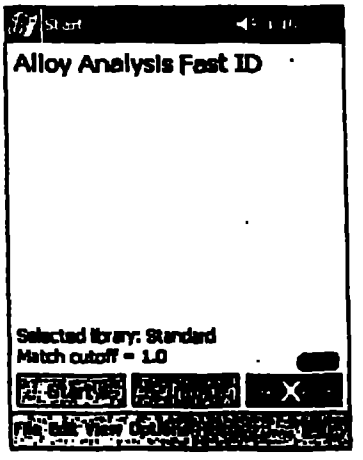
When the trigger is depressed, the analyzer supplies power to the x-ray tube and opens the shutter to emit x-rays. The analyzer is equipped with a trigger lock to prevent the user from accidentally beginning a test. Slide the lock from left to right to lock the trigger.

Recommended Operation: When the system is not in use, slide the trigger lock to the right to "lock" the trigger. This will prevent a person from starting a test accidentally when they grab the analyzer. The location of the trigger lock is shown to the right.

The trigger must be depressed for the duration of the test. Releasing the trigger will close the shutter and immediately end the test.

Figure 3.1 Handle of analyzer trigger and trigger lock are located at top of handle.

Starting a Test Using the "Start" Icon on the iPAQ Screen



This feature is disabled in all units shipped. It will become active only if the "deadman" trigger is disabled.

An operator may also begin a test by pressing the Start button on the touch screen, as shown at the right. The Start button, rather than the trigger, is generally used when the analyzer is docked into the testing stand. As an additional safety feature, the Start button also provides for "two handed" operation of the analyzer. To require two-handed operation, set the trigger lock by sliding the switch left to right. This will require the user to hold the analyzer with one hand and start a test by using the other hand to press the Start button.

This Feature is not available in Canada. All tests must be started via the trigger.

3.5 CORRECT AND INCORRECT INSTRUMENT USAGE:

The Innov-X XRF analyzer can be used in several different testing configurations. Safety guidelines are described for each configuration.

Configuration 1: Usage as a Handheld Alloy Analyzer:

In this configuration the analyzer is held in the hand, placed on various types of samples and a test is performed. Samples include pipes, valves, large pieces of scrap metal, basically any sample large enough to be tested in place, rather than held in the operator's hand. Point the instrument at a metal sample such that no part of your body including hands and/or fingers is near the aperture of the analyzer where x-rays are emitted.

Using the analyzer in this manner assures that the operator will not obtain a radiation dose to any body part or extremity in excess of naturally occurring background radiation. The radiation at any surface of the analyzer is < 0.1 mR/hr except at the exit port and the immediate area around the exit port.

The user should take care that personnel are not located within 3' (1 m) of the front end of the analyzer during testing, in the direction of the x-ray beam. Provided the analysis window is completely covered, there is virtually no radiation being emitted around the area of the sample. However, if a small component or curved surface is being analyzed, some radiation will be detectable.

Configuration 2: Usage in the Testing Stand

Innov-X strongly recommends that testing small pieces or small samples (rod, fasteners, turnings, XRF sample cups, bagged samples, etc.) be analyzed using the Innov-X Testing Stand. This allows the sample to be placed onto the analysis window of the analyzer without requiring the sample to be held by the operator. See figure below titled "Testing Stand Operation."

Note: If you are using the analyzer without the interlocked cover (as shown in Fig 3.2 below), be sure the analyzer is oriented such that the bottom of the handle is pointing towards the operator and the top of the analyzer (where the PDA normally is located during handheld operation) is pointing away from the operator. This configuration assures that any stray radiation emitted will be directed away from the operator, and there will be no detectable radiation exposure to the operator.

Note #2: Do not allow personnel to stand on the opposite side of the analyzer with respect to the operator's location as described in Note #1. Stray radiation may be emitted from the analysis area, particularly if the window is not completely covered, and that radiation will be directed upwards and away from the operator, provided the analyzer is oriented as described in Note #1.

Figure 3.2 Testing Stand Operation. Please refer to Section 2.7: Testing Stand for assembly instructions.

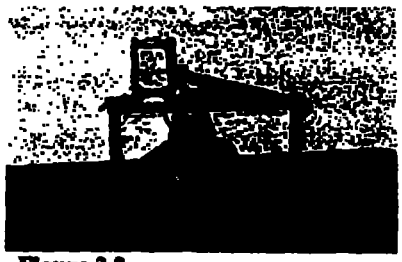


Figure 3.2.

Warning: Innov-X strongly recommends that operators do NOT hold samples in their hand for testing. Never hold a small sample in your hand, and test that sample, such that your hand is exposed to the x-ray beam being emitted from the analyzer. This type of testing produces a small but non-negligible radiation dose to the operator's hand. Please see Section 3.7: Radiation Doses for Several Scenarios for dose levels. Also, see Figure 3.4 for an example of incorrect usage.

Testing of Small Components:

Operators often are required to test small components, particularly in the field of alloy analysis. Examples of small samples include turnings, weld rod, wires, fasteners, nuts and/or bolts.

There are specific procedures to test small components. These procedures should be followed at all times. Never hold a small part with your fingers or in the palm of your hand and perform a test. Doing so may deliver a significant dose of radiation to your fingers or hand. Please refer to the Examples of Mis-use below.

Method 1: Testing a sample lying on a flat surface.

Figures 3.2.(a) and 3.2(b): Performing a testing for a sample lying on the surface of a table. This is a good way to test small samples, rather than holding them in your hand.

To analyzer small sample:

- Place the sample onto a flat surface.
- Place the window of the analyzer onto the sample and begin the test.

Safety Precautions:

Do not test samples in this manner at a desk or table where the operator is sitting are sitting. If the desk is made of wood or another non-metallic material, some radiation will penetrate the desk and may provide exposure to legs or feet if the operator is sitting at the desk or table.

Analytical Precautions:

If the sample does not completely cover the window, be sure the surface used does not contain metals or even trace levels of metals, as this may affect the accuracy of the XRF result. The XRF may report the presence of additional metals in the surface material. For this type of testing, it is good to place the sample onto a piece of 1100series aluminum alloy and perform the analysis. The operator should disable the aluminum analysis capability (See Section XX in the manual for instructions).

Method 2: Use the testing stand as described above (see also Fig. 3.2).

Examples of Incorrect and Possible Unsafe Operation:

Improper Operation, DO NOT TEST SAMPLES LIKE THIS:

Exposure to the operator's hand/fingers will likely be minimal for this type of a testing, because the operator's hands and fingers are not in the primary beam. However, Innov-X believes that this type of the analyzer sets a poor safety precedent in that any operation where the operator places their fingers or hands near the window should not be permitted.

Figure 3.3. Incorrect Usage. While the dose to the operator's fingers/hand is negligible, testing this way sets a poor safety example for other operators, possibly encouraging other unsafe usage. Innov-X strongly recommends against this type of testing.

DO NOT TEST SAMPLES LIKE THIS:
Never hold a sample in your hand such that any part of your body or appendages are exposed to the x-ray beam. Testing samples in this way may generate significant radiation exposure (up to 27 R/hr) to the operator's fingers.

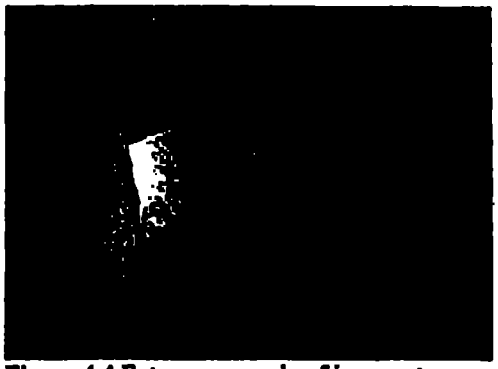


Figure 4.4 Extreme example of incorrect usage. An operator should NEVER hold small samples by hand

3.6 RADIATION WARNING LIGHTS AND LABELING:

3.6.1 Probe Light and Probe Label:

The Innov-X analyzer is equipped with warning lights that alert the operator when the tube is receiving power, and when x-rays are being emitted from the analyzer. Please see Fig. 3.5.

When the red light on the front nose of the analyzer is ON continuously (not blinking), this indicates the x-ray tube is receiving a low level of electrical power and the shutter is closed. The system is producing a low level of x-rays internally in this condition, but the shutter is providing adequate shielding to keep x-ray levels below levels of detection. The instrument is safe to be carried around or set down in this configuration.

When the red light is blinking, this indicates the tube is powered, the shutter is open and the analyzer is emitting x-ray radiation out of the analysis window. The analyzer should only be pointed at a sample, or be in the testing stand with a sample resting on the window, in this configuration.

3.6.2 Testing Light on Back of Analyzer:

The light on the back of the analyzer, shown in Fig. 3.6, is lit while a test is active. During a test – x-ray tube is energized and shutter is open – an LED on the back of the analyzer is lit. This LED remains lit until the test has ended. This light is for testing conditions (i.e. overhead) where the operator cannot see the Probe Light or the iPAQ display. The light turns off when the test is complete. When the light is off, the tube is de-energized and the shutter is closed.

3.6.3 Label Behind iPAQ:

The analyzer also has a label just below the iPAQ indicating, as shown in Figure 3.7:

CAUTION: Radiation. This Equipment Produces Radiation When Energized.

This label is required by most regulatory agencies. The term "When Energized" refers to the condition where the tube is fully energized and the shutter is open. This condition is also indicated by the red blinking light on the probe.

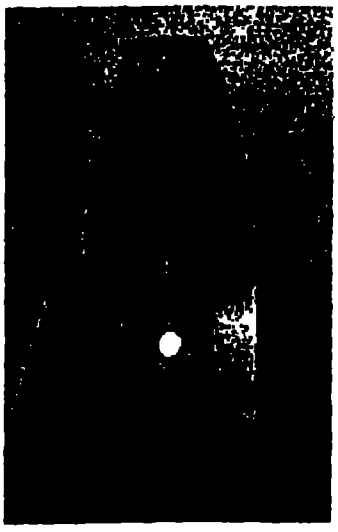


Figure 3.5. Probe light and labeling. When the light is on continuously, the x-ray tube is receiving minimal power and it is producing a minimum level of x-rays. The shutter is also closed so there is no radiation exposure to the operator or bystanders.

Figure 3.6. Back light on analyzer.

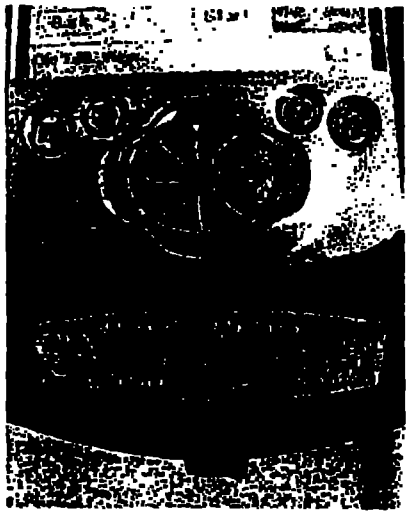


Figure 3.7. Label behind iPAQ.

3.7 RADIATION LEVELS FROM ANALYZER

Two pictures of the analyzer are shown below. In the first picture, all the relevant components referenced in this radiation safety section are displayed and labeled. The second picture shows a close-up of the front end of the window. The four sides A, B, C and D are indicated on this picture because they are referenced in terms of radiation levels output by the analyzer. The measured radiation levels for standard operating conditions are shown in the figures and tables below. Standard operating conditions are tube voltage operating at 35 kV, tube current of 5 uA, and 2 mm aluminum filtration.

Figure 3.8 Innov-X Analyzer, Side View

Figure 3.9 Innov-X Analyzer, Front View

Radiation Levels (mrem/hr) for Alloy Analysis, Standard Beam Conditions: 35kV, 5 uA, 2mm aluminum filtering:

Sample at Window	Trigger	Location A (Top)	Location B (Right Side)	Location C (Bottom)	Location D (Left Side)
Blank (Air)	<0.1	<0.1	<0.1	<0.1	<0.1
Metal	<0.1	<0.1	<0.1	<0.1	<0.1

Table 3.1. Dose rates (units of mrem/hr) at various locations with a metal sample covering the window and with no sample present. For "no sample" the analyzer is shooting the x-ray beam into air.

As shown in the Table 3-1, the dose to the operator's hand is negligible. The radiation levels at the side surfaces of the instrument snout (aluminum housing) are all <0.1 mrem/hour. Despite these low levels of radiation, there is no reason for any body part to be in the locations denoted A, B, C and D!

Table 3-2 shows the radiation levels directly in the x-ray beam that is emitted from the analyzer. Radiation levels at the exit aperture (or "port") are substantial. There is no reason for the operator or any personnel to be exposed by the direct beam. Operators should never hold samples in their fingers or cupped in their hands, as this may generate a significant radiation exposure.

Operations should never point the analyzer at another person and start a test, as this may also provide significant exposure to the person if they are within a few inches of the port of the instrument.

Radiation Levels in the Primary Beam Versus Distance from Port:
For Alloy Analysis, Standard Beam Conditions: 35kV, 5 uA, 2mm aluminum filtering:

Tube Conditions	At Trigger, or any part of operator's body.	At Window	4 inches	12 inches	36 inches	48 inches
35 kV, 5 uA, 2 mm Al filtering	<0.05	28,160	2,080	186	24	14
15 kV, 25 uA, thinner filter material	< 0.05	27,780	1,620	145	19	11

Table 3.2. Dose rates (units of mrem/hr) in the direct x-ray beam being emitted from the analyzer

3.8 RADIATION DOSES FOR SEVERAL SCENARIOS

In this section we provide data, concrete examples of use and misuse of the analyzer and common questions and answers we encounter when training personnel on the safe use of the Innov-X analyzer. The goal is to explain scenarios of safe versus improper usage of the analyzer.

The table below presents radiation doses for normal operating conditions and also for examples of misuse of the analyzer and even extreme misuse. Innov-X provides installation training that includes detailed radiation safety training and documentation designed to prevent misuse of the analyzer.

Example of Instrument Usage	Radiation Exposure and Comments
Normal Operation - Dose to Hand: User analyzes samples according to standard operating procedures described in this manual. Assumption: Operator using system with x-ray tube ON for 8 hours/day, 5 days/week, 50 weeks/year. (Practically constant usage).	Maximum exposure is to operator's hand, at the trigger. Exposure is < 0.1 mrem/hr. Annual exposure to hand is then < 200 mrem (2uSv). US: Maximum exposure under OSHA regulations is 50,000 mrem annually. Thus continuous operation provides a dose that is at least 250 times lower than maximum allowed by OSHA. Canada: Maximum exposure under ICRP regulations is 500 mSv for radiation workers and 50 mSv for the general public. Thus continuous operation provides a dosage 250 times lower for a radiation worker and and 25 times lower for the general public.
Normal Operation – Dose to Torso: Analyzer is used under the same operating conditions described above.	Exposure to Torso is so low it cannot be measured. To be conservative we use the same figure as the trigger, < 0.1 mrem/hrAnnual exposure using highly conservative operating conditions above is < 40 mrem. (0.2 uSv) Maximum allowed is 5,000 mrem under OSHA and 20 mSv under ICRP for radiation workers (1 mSv for general public).

Misuse Example 1:
Operator holds samples in front of window with fingers, such that fingers are directly in the primary beam. Do not do this!.

For fingers at the port, in the primary beam, the maximum dose to the fingers is 27,000 mrem/hr. Assume an operator performs a 10 sec test (typical). The dose to the operator's fingers or hand is 27,000 x (10/3600) = 75 mrem. If the operator did this 666 times/year they would exceed the allowable annual dose of 50,000 mrem to an extremity.

If the test time was 30 seconds instead of 10 seconds, the operator would exceed the annual safe limit of 50,000 mrem after 222 tests.
Even though it is unlikely to make this mistake so many times in a year, do not even do it once. Take the extra time to test a sample on a surface or use a testing stand.
Dose is about 440 mrem/year 4.4 mSv (year).
Maximum allowed dose is 50,000 mrem/year (US OSHA), 500 mSv/year (Canada ICRP radiation worker) or 50 mSv/year (Canada ICRP general public).

Misuse Example 2:
Operator places analyzer against body and pulls the trigger to start a test. Analyzer tests to preset testing time (usually 10 seconds) unless operator pulls trigger again to stop test. This applies to analyzer being in contact with operator or with bystander.

Dose at exit of sampling window is 27,000 mrem/hr.
Dose for a 10 second exposure with analyzer in contact with Torso: 75 mrem (.75 mSv).
US: If an operator did this act 66 times in a year, the operator would exceed the annual safe dosage to the torso.

If the testing time was 30 seconds instead of 10 seconds, thus the operator placed the port against his body or that of a bystander and performed a 30 second test, the dose would be 225 mrem. This is about the same as a mammogram. Repeating this gross mis-use 22 times would exceed the annual allowable limits.
Canada: Radiation worker would have to repeat this example of gross misuse 26 times to achieve the ICRP level of 20 mSv. (general public 1.3 times to achieve limit of 1mSv)

Misuse Example 4:
Operator manages to initiate a test for 10 seconds and exposes a bystander that is standing 12" away from analyzer port. What is exposure to bystander?

Note: The proximity sensor would automatically shut down the x-ray tube after 2 seconds, so this is an extremely improbably occurance.

Note 2: Equations to scale these to other scenarios involving longer or shorter tests, and bystander being at distances other than 12" are provided at right.

Dose to bystander at 1 foot is 350 mrem/hr. For a 10 second exposure dose is 1 mrem. This is 5,000 times lower than the allowable dose to a worker in a year. This would have to happen 5,000 times to for that worker or bystander to obtain the maximum allowable dose.

Formula for calculating other scenarios:

$$Dose = 1\,mrem\left(\frac{13.25}{D+1.25}\right)^2 x\left(\frac{t}{10}\right)$$

D = distance from port in inches
T = testing time

Example: Bystander is 3' away from port for a 30 second test. In this case the dose is calculated as:

$$Dose = 1\,mr\left(\frac{13.25}{36+1.25}\right)^2 x\left(\frac{30}{10}\right) = 0.38 mrem$$

US OSHA: Maximum allowable level is 5,000 mrem assuming bystander's torso is exposed. Thus, this misuse would have to occur 12,500 times in a year to the same bystander before that bystander achieved his maximum allowed dose.
ICRP: 5000 times for rad worker, 250 for general public

Comparative: Radiation Doses from Typical Exposures to Ionizing Radiation

Common medical and/or dental x-rays:	20-30 mrem each.
Mammogram:	100-200 mrem
Flying in a commercial jet coast to coast (6 hrs.):	1-2 mrem.
Daily exposure from background radiation: * depends on geographic location	0.3 to 0.5 mrem/day

Table 3.3 Radiation Doses from Typical Exposures to Ionizing Radiation

From the above table, nearly all the cases of analyzer misuse produce radiation exposures similar to flying in a commercial aircraft. Moreover, the typical exposure from a case of significant instrument misuse produces roughly the same dosage as the daily dose of radiation from naturally occurring background radiation.

3.9 COMMON QUESTIONS AND ANSWERS REGARDING RADIATION SAFETY

Question: When I'm shooting a piece of pipe or valve on a rack or on a table top, is there any exposure to people standing in other locations, or standing several feet away from the analyzer?

Answer: Even a thin amount of metal sample (1-2 mm thickness) is enough to completely attenuate the x-ray beam emitted from the Innov-X analyzer. Shooting a piece of material that covers the sampling window on the analyzer will completely shield any bystanders from radiation exposure. However, good practice recommends that the area for at least 4-5 feet in front of the analyzer is clear of people.

Question: If I forgot to switch the safety on the trigger to "ON", I pick up the analyzer and accidentally pull the trigger, is that dangerous to nearby personnel?

Answer: No, this example of misuse is not dangerous, but it may produce a non-negligible radiation exposure to nearby personnel. For an exposure to occur, the following things must happen. First, you must be holding the analyzer so that a bystander is actually standing in the x-ray beam being emitted. Just being near the analyzer is totally safe otherwise. Second, the bystander must be within 1-3 feet from the nose of the analyzer in addition to being in the beam path, to receive any appreciable dose. If all of these conditions are true, the dose received by a bystander is still extremely low. It ranges between 0.1 to 0.5 mrem depending on the exact location of the bystander. This dose is 10,000 to 50,000 times less than the allowed dose. Please see Misuse Example 4 in the table above.

Question: Do I need to create restricted areas where I am using the analyzer?

Answer: No, provided you are following normal operating procedures there is no reason to restrict access to an area where the analyzer is in use. The operator should take precautions to keep any personnel more than 3 feet away from the sampling window of the analyzer in the event of accidental misuse as detailed above. Should the operator also elect to test small components like weld rod as shown in Figure 3.3, the operator should also be sure that no personnel are standing within about 4-5 feet of the sampling window.

Question: How does the x-ray tube in the Innov-X system compare to a radiography system used for taking images of metal parts.

Answer: The x-ray tube used in the Innov-X system produces between 1,000 and 10,000 times lower power than most radiography systems (0.5-1 watt for Innov-X versus kW for radiography systems). This is because a portable XRF is designed to perform surface analysis of alloys and other samples, whereas radiography systems are designed to shoot x-rays entirely through metal components in order to obtain an image on the other side of the object being bombarded with x-rays. For example, many tube-based radiography systems use a 300-400 kV tube and currents in the tens or hundreds of milliamps (mA). The Innov-X analyzer uses a tube operating at 35 kV and 5-30 micro-amps. The radiation levels produced are therefore thousands or tens of thousands times lower with the Innov-X system.

Question: Should we use dosimeter badges with the Innov-X analyzer.

Answer: Dosimeter badges are required by some states, and optional by other states. Innov-X recommends that operators wear badges, at least for the first year of operation, as a general precaution to flag any misuse of the analyzer. Dosimeter badges are available for the torso (generally worn on the belt loop or shirt pocket) and are available as "ring" badges. The best single badge to obtain is a ring badge that is worn on a finger, on the opposite hand used to hold the analyzer. This will record accidental exposure for the most likely case – an operator grabbing a small sample and holding it in one hand while analyzing it. Note: these badges generally have a threshold of 10 mrem, and are renewed monthly. So it will take several cases of misuse even to obtain a reading on a typical badge. When purchasing a badge, obtain the type used for x-ray and low energy gamma ray radiation.

3.10 SAFE GUARDS AND EMERGENCY RESPONSE

The main safeguards to use as an owner of an Innov-X portable XRF are really intended to restrict access to properly trained operators:

1. Keep the system in a controlled location, where only authorized users are likely to have access to the analyzer at any given time.
2. Make a simple sign that is kept with the analyzer indicating that an operator must have completed a training class provided by your company or must have attended an Innov-X training course in order to use the analyzer. Note that when the Innov-X system is turned on, the screen displays a message indicating that the system should only be used by authorized personnel.

Emergency Response:

Because the Innov-X system is a battery operated, x-ray tube based analyzer, the emergency response plan is very simple. If the operator believes the analyzer is locked up in an "OPEN" position, they should do two things:

1. Press the On/Off switch on the base to power the analyzer off. The green LED indicator will turn off, indicating system power is off. At this point it is not possible for the analyzer to be producing x-rays.
2. As an additional precaution, the operator may remove the battery trap door at the bottom of the analyzer (have the nose pointing away from personnel), and pull out the battery. Even if the operator has failed to properly power the system off in Step #1, removing the battery guarantees that no x-rays can be produced. There is no electrical power being provided to the x-ray tube.

Note: It would be highly unusual for an operator to somehow lock up the analyzer with the x-ray tube powered on. This would require the operator to crash the iPAQ during an analysis. If this happens the analyzer will shut off the x-ray tube 10 seconds after the last communication with the iPAQ. However, if at any time the operator believes the x-ray tube is on and no test is in progress, powering off the analyzer and restarting will automatically shut down the x-ray tube and close the shutter. It will no longer be possible to produce x-rays at this point.

3.10 DOSIMETER BADGES

Dosimeter badges are provided as a monthly service by several companies, listed in this section (see below). The badges are generally provided monthly, and the operator returns the previous month badges to the company for analysis. The operator receives a monthly report showing any personnel with readings higher than typical background radiation.

Dosimeter badges are required by some states, and optional by other states. Innov-X recommends that operators wear badges, at least for the first year of operation, as a general precaution to flag any misuse of the analyzer. Dosimeter badges are available for the torso (generally worn on the belt loop or shirt pocket) and are available as "ring" badges. The best single badge to obtain is a ring badge that is worn on a finger, on the opposite hand used to hold the analyzer. This will record accidental exposure for the most likely case – an operator grabbing a small sample and holding it in one hand while analyzing it. Note: these badges generally have a threshold of 10 mrem, and are renewed monthly. So it will take several cases of misuse even to obtain a reading on a typical badge. When purchasing a badge, obtain the type used for x-ray and low energy gamma ray radiation.

Dosimeter Companies:

Here are two companies that provide badges as a regular service. There are certainly many more.

Landauer Inc.	AEIL
Glenwood, IL	Houston, TX
708-755-7000	713-790-9719

3.11 TYPICAL REGISTRATION REQUIREMENTS

Innov-X maintains a database of the registration requirements for every state, including sample registration forms. Most states require some form of registration, and generally they require the registration to be received within 30 days of receipt of the instrument. Some states require no registration, while a few require notification in advance. Please contact Innov-X for specific questions regarding the state where the instrument will be used, or for copies of registration forms.

In general a company will have to provide the following information regarding the device:

1. Purpose of device. Generally this is "Analytical" or "Industrial." Be sure to inform the state registration office that the device will NOT be used for radiography or for medical uses.
2. Radiation Safety Officer – Monitors training, safe use, and controls access to the instrument.
3. Authorized Users – Trained by Innov-X Factory Authorized Representatives in the safe and proper use of the XRF.
4. Operating parameters of the analyzer – 35 kV, 5-30 micro-amps.
5. Type of system, either fixed, mobile or portable. Generally the correct choice is "Portable."
6. User Training Specified – Indicate that only individuals receiving manufacturer training, documented by a manufacturer's training certificate will operate the instrument.
7. Personal Monitoring. This may be required by radiation control authorities. Many registration forms will ask that you indicate whether or not you intend to perform dosimeter monitoring.
8. Copy of Registration & Manual at the Job Site

If you have any questions regarding the type of registration form or filling out the form, please contact Innov-X Systems. Many states may confuse a portable XRF system that uses a tube with medical or industrial radiography systems. This is because of the relative newness of portable tube-based systems. In all likelihood, Innov-X personnel have experience providing the necessary documentation to the state in question, and can readily assist the customer in this process.